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AVIATION

The Oldest American Aeronautical Magazine
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Edward P. Warner, Editor

Louis F. Stoll, Publishing Director

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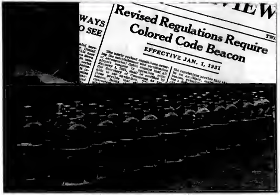

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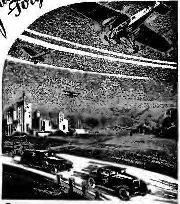


This New

AVIATION

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The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

. . . *January, 1931* . . .

TURN OF THE YEAR

TWELVE months ago the aircraft world was at the end of an era, and had not yet admitted it. The great boom had come to an exorable end; deflation was inevitable, but the horrid truth had not, with rare exceptions, been accepted by either manufacturers, operators, or contributors to the glut of capital by which aeronautical enterprises had been beset.

Again we face a year, but this time without decisive shift of the industry's position to accompany the hanging up of a new calendar. Roughly speaking, deflation began with 1930. At the end of 1930, it has not yet reached its terminus. As we look forward to a new flying season and a new national aircraft show; as rumors of spectacular new models, sales plans, and price cutting campaigns again fly through the industry; we have to reckon with an essential continuation of the process that has marked the past year.

But we shall not survive that process most effectively, and we shall not escape its devitalizing action so far as we well might, by sitting with complacently folded hands to await the completion of the deflation era. We shall get nowhere by blaming our troubles on "a disequalibrium of world credit," or any of the other general factors enumerated by the recent international conclave of economic experts on depression. Our depression was manifest on the horizon before there had been more than whispers of trouble in the great financial centers. Depression in aeronautics started ahead of the general business depression, and it has reached the bottom of the slough of despond and has started the slow process of recovery ahead of general business. We have not reached the end of the deflation era during the past year, but we have seen the worst. From now on the tendency will be upward.

A forecast of business for 1931 is made elsewhere in this issue in numerical terms. We are talking here rather in terms of states of mind.

The one great fact to bear in mind is that even if there were to be no increase in aircraft production there still need be no despair. The aggregate business done by manufacturing companies in 1930 materially exceeds the figures of 1927, and closely approximates those of 1928, years in which the industry fancied itself basking in the smiling sun of prosperity. In 1930, with the same amount of business done, we have fallen into the habit of talking as though the end of the world were at hand. Depressed states of mind are a mark of deflation, but the time for showing them is past. Admitting that further retrenchment is needed, that the number of individual manufacturing units now functioning is two or three times that for which any possible justification exists, it remains true that we have enough business to run an industry successfully even in a period of despondency.

What we most require is a new scale of measurement. We have heard so much talk of the analogy with the automobile business that it has gone to our heads. If the whole industry would expunge from its collective mind the notion that we are headed for a production of five million airplanes a year, and get rid of the idea that we are to follow in the footsteps of four-wheeled highway vehicles in an expansion without precedent in industrial history, we shall be able to take a saner outlook on our own present as well as on the future.

When one starts making estimates with too many zeros

on the right-hand and of one's figures, the zeros have a regrettable habit of transferring themselves to the left-hand side of the column. Suppose we compare, for a change, with locomotive production, which is a sound and respected business, and which aggregates around seventy-five million dollars a year, only about 50 per cent above our production of airplanes in this year of lamentation.

We of AVIATION hope for growth, as does the whole industry. We want to see things done that will make it possible and that will multiply production and sales, but even at the present,—even without introducing any innovation,—we heve a perfectly good business in our hands. The industry is gradually being reorganized to make the most of that business. Necessary reorganization is not yet completed, and it is in that sense that deflation still continues, but the deflation that we heve henceforth to face is one of readjustment rather than of straight horizontal reduction. Individual units in the industry are going to meet bitter hardship, and some are going to give up the struggle, but the industry as a whole has made the turn to the upgrade.

The foremost requirement for taking advantage of existing possibilities is an energetic continuation of sales effort. There has been a spirit of defeatism in many quarters. A feeling hes arisen thet sales might as well be left to make themselves without conscious search for customers.

That way lies disaster. If sales effort has seemed to be wasted, and if such sales as have been made have been the results of happy accident rather than of deliberate quest, it proves only the need for a more careful study of the market and its desires. We said all that a year ago. We say it again now. Airplanes can be sold, —not a hundred thousand airplanes a year, but a very substantial number. They can be sold by finding people who are in a position to buy and who have some definite use for the machine, and by analyzing the cause of every failure to make a sale. The sale of airplanes has become a matter of economics. Customers can no longer be persuaded to buy machines for their supposed publicity value, nor can they be induced to produce their cheque-books by picturesque tricks of salesmanship. A grain of analysis of the needs of the customer will be worth a ton of "cleverness" in merchandising in 1931.

SOARING SCIENCE

IT HAS taken something more than a year of very exciting and costly experience for us to learn in America that there are two kinds of motorless flying—that gliding and soaring denote entirely distinct pursuits—and that neither one is a foolproof pastime with which uncoached school boys may supplement baseball.

Gliding, where no rising air currents are available, is of no benefit either to aeronautical or meteorological science. It is unlikely to lead to any contributions to aircraft design. Its charm as a sport very quickly wanes for most, although not by any means for all, of those who engage in it. Its direct effect on the sales of the industry is negligible. It has only one lasting value, but that one is of first-rate importance, and must not by any means be underestimated. It helps to make flying look simple and commonplace.

We still suffer in promoting aviation from the conviction of a great body of ordinary citizens thet there is something tricky about it, something that can only be mastered by those specially qualified and after long application. We suffer from the notion existing in the same quarters that the airplane is a beast of volatile temperament, not really understood even by its professional mahouts, and liable to the most eccentric behavior.

Right there gliding comes in. It is difficult to maintain any such delusions in the face of the fact thet one's own nephew and his best friend and the neighbor's boy across the street, ranging in age from fifteen to nineteen, have all mastered the ability to keep an aircraft right side up and talk learnedly about the action of its controls within three or four afternoons' practice. Many of the glider pilots will abandon gliding in the course of a few months and turn to some other fad. They do not offer any huge market for equipment, such as a part of the industry optimistically foresaw last spring, but they do offer a very definite prospect of a calmer and more reasonable attitude, on the part of their relatives and their relatives' friends, towards flying as a human activity. If the aircraft industry is farsighted, it will encourage gliding and try to keep glider clubs continuously alive in spite of their frequently heavy turnover of personnel. The industry should support the glider, not as an immediate means of keeping its factories busy, but by way of developing good will which will begin to pay dividends two or three years hence.

But that is only one side of motorless flying. There is another, certainly at least as important, almost forgotten during the past summer in the rush for high-pressure commercialization, for mass production, and for spectacular and picturesque demonstration.

With a favorable terrain, proper equipment, and all other conditious suitable, gliding grows into soaring. And soaring offers both the superlative opportunity for display of the pilot's art and an instrument of research of the first calibre.

AVIATION has been very sceptical about the glider movement in its original presentation, and very conservative in its support. Our interest in soaring flight and our desire that it should be studied as intelligently and as exhaustively in the United States as it has been in Germany, on the other hend, knows no bounds. It was with particular pleasure that we made our contribution to the success of the National Soaring Meet at Elmira by providing all the prize money for the altitude contest and by keeping members of our staff on the scene for a considerable part of the meet to assist in

conducting the contests. The technical results justified our fondest hopes.

The pilot of an aircraft can never ignore the nature of the medium in which be travels, but he has little opportunity of investigating its peculiarities while cruising at 120 miles an hour along transport routes. The chance for really careful study of atmospheric structure, analyzing all the odd responses of the flow of air to irregularities of terrain or of cloud formation, comes only to the soaring pilot. The information that he secures is of immense importance for the safe and economical operation of aircraft. The transport operator and the manufacturer had better take him as a valued partner, not view him with patronizing tolerance as a boy engaged on playthings. Soaring research deserves energetic promotion both by the industry and by the N.A.C.A., the universities, and other scientific institutions. The name of Robert Kornfeld, greatest of soaring pilots, deserves to be honored wherever men think seriously of flying.

ROME WAS NOT BUILT IN A DAY

SQUASHES mature in a few short weeks, and are nothing but squashes. The oak tree takes years to develop and is one of the mightiest works of nature. A great and enduring industry must be gradually erected over a considerable period of time. No great work is accomplished overnight. It is unreasonable to expect aviation, which was only a dream for thousands of years, and little more than a plaything until within the last fifteen, to grow up overnight into equality with the other major transport industries of the world.

Air transport is the latest and most novel step in the history of world transportation development. No other step has been hurried. Ocean shipping took hundreds of years to develop. Steam railroads extended their development over generations. The commercially applicable transport airplane did not exist in any acceptable form until after 1925 and is still in evolution.

Air transport is revolutionary. It contradicts all established modes of thinking and acting. To inplant it io the fabric of industrial life wa must completely upset the present order of business. Eventually the whole world will be geared to the new pace, but to accomplish such a great change we must allow sufficient time for the old methods to be re-molded.

Especially for tha past three years we have been possessed of a mania for realizing the "Air Age" overnight. We have tried to reach tha horizon in a single jump. We have found the general public and the average business man slow to respond to a program of which they were by nature suspicious because it concerned matters absolutely foreign to the personal experience of most of the individuals concerned. Air transport has been a new and untried factor in travel and is being required to prove and re-prove itself before receiving universal patronage.

It will be a good thing for air transport, for aviation in general, and for all organized industry if aeronautical executives will pay more attention to continuity than to speed in progressing toward the "Air Age." The less disturbance of business thet is caused by the establishment of air transport the better for all concerned. We have right now a splendid opportunity for us to get our visions of the aeronautical future into proper relation with our common sense understanding. The dreamers heve had their day. Let the industry now follow the plodder who looks before he leaps and who makes every step count.

A CONFERENCE— AND THE CHAMBER

IN THE editorial "A Conference That Got Results" in the November issue of AVIATION, the endeavor to economize space led to an omission of explicit mention of the part played by the Aeronautical Chamber of Commerce in paving the way for the meeting of the industry with the Department of Commerce. The success of the meeting in Washington was, as our previous editorial observed, the result of careful advance preparation. The preparation itself was, as everyone on the scene fully realized, mostly the work of the commercial manufacturers' section of the Chamber, which called a meeting at which a preliminary consensus of the views of the industry was obtained and the way prepared for a plain and concise expression of the collective opinion to the Department. As we heve already observed editorially, the method functioned so admirably as to set a standard for the future, and there should be no withholding of credit from either individual or organization that shared in making the plans and executing them.

SPEAKING OF RESEARCH

NOTHING is easier, and nothing demands less courage, than attacking scientific work for the benefit of a non-scientific audience. The general public, and even most of us who are engaged in applying science to industry, have little understanding of scientific theories or of laboratory work, and it is immensely consoling to feel that people who pretended to be so much wiser than we ourselves, and claimed to "understand all that stuff," were wrong all the time.

To assail the scientist is the safest of pursuits, for he

has neither the inclination nor the equipment for rebuttal. Reasoned and orderly discussion in reply to a vindictive assault on the caliber of work done in a laboratory is quite impossible before an audience that has no background of experience of its own to give it an understanding of the nature of the controversy.

The National Advisory Committee for Aeronautics has had its share of vilification. Perhaps no answer, and not even passing comment, is necessary. The steady growth of interest in the industry's pilgrimages to Langley Field, annual since 1926, and the lively discussions thet take place there, give evidence of the esteem in which manufacturers and operators hold the N.A.C.A. Nevertheless it is worth recalling how much influence that body's activities have already had on American aeronautical development. Let us take an example.

The venturi and ring cowlings are the most conspicuous of recent contributions to aerodynamic efficiency. They are the exclusive invention of no individual or group. Their genesis can be traced back at least to 1920. They have appeared in various forms here and abroad,—but the most important single step in practical appliestion was the direct quantitative proof of the reduction in resistance they permitted. Without the tests that were made at Langley Field, the new forms of cowl might have been suggested and argued and perhaps tried in a small way, but their general acceptance would have been a matter of many years. Even in England, the original home of the ring, its adoption as a standard feature of airplane design has been enormously accelerated by the American laboratory work, which has given generalized in place of specialized results, and definite measurements of resistance in place of speculations based on a measurement of maximum speed. The most important function of the Committee, in short, was not to invent a new type of cowling, but to determine the relative merits of all available types and to make the determination on a scale which no other laboratory in the world was prepared to duplicate.

It is a good general rule thet there are three types of research work, and they are adapted to three different types of organization. First, and in the very long run most important, is contribution to pure science and underlying theory, perhaps most generally the product of members of the staffs of educational institutions or of laboratories endowed by private capital or by especially farsighted industries. At the other extreme is the study directed to solve a particular and specialized problem of a particular design, or to lead directly to the invcotion of a new proprietary device, and that is the proper sphere of the research department of a corporation. It is a sphere, be it said in passing, not as yet sufficiently exploited by American airplane manufacturers, for in the face of the great affluence of the industry in 1928 and 1929 the absence of research departments in most airplane factories remained a proper ground for surprised comment by foreign visitors and for shame-faced acknowledgment by American engineers.

Between the two extremes there is a third class of work, the conduct of "practical" studies, general but immediate in their application. That is the particularly fitting task for a government laboratory.

To produce a theory of heat flow which will make it possible to calculate the cooling characteristics of an air-cooled cylinder is the function of an individual mathematical physicist, and it is on a college faculty that he will most often be found. To determine the cause of repeated spark-plug failure in the XYZ engine is the responsibility of the XYZ Engine Company. But to find out by actual measurement on a group of typical engines how temperatures are typically distriboted in cylinders and how they are affected by changing conditions of flight, information thet can be applied to the XYZ engine or any other, is work most profitably to be undertaken for the general good, and for general dissemination of the results, by such a body as the Advisory Committee.

The determination of design data may not be inspiring or spectacular. It does not appeal to the imagination as does an invention, but it is extraordinarily important. Without it, design does not progress.

The structural design of every airplane built in the United States today is dependent to some degree upon the N.A.C.A. work on pressure distribution and air loads in flight. The structure of seaplanes has gained a rational foundation for the first time through the studies made on pressure distribution on float bottoms. The airship being built at Akron will be a stronger and a lighter craft than would be possible without the N.A.C.A. measurements on the Los Angeles. Examples can be multiplied without number.

Science is a term thet covers a multitude of widely different things. Not the least important among them is the skilful devising of means for accumulating data upon which the designers of engineering material may lean.

The Advisory Committee has acquired the material and the personnel to do that work for American aviation, and has been doing it. Aeronautical engineers in Europe are quick to express their envy of their American colleagues' good fortune in having at their disposal an institution of such resources.

Genealogy of AVIATION

AVIATION was founded by Lester D. Gardner, the first issue appearing Aug. 1, 1916, as *Aviation and Aeronautical Engineering*. In 1920 the *Aircraft Journal* was absorbed and the title became *Aviation and Aircraft Journal*, to be simplified into AVIATION in January, 1922. The chief editors have been Ladislas d'Orcy, W. Lawrance Le Page, Earl D. Osborn, R. Sidney Bowen, Jr., and Edward P. Warner.

The present staff consists of Edward P. Warner, editor; Leslie E. Neville, managing editor; R. Sidney Bowen, Jr., contributing editor; Charles F. McReynolds, Pacific Coast editor; Charles H. Gale, Daniel Sayre, and David J. Leisk, assistant editors.

The Trend of Activities

SALES, PRODUCTION AND GENERAL

THE Curtiss-Wright Flying Service has announced that its photographic division has completed work on photographing 8,900 sq.mi. for the United States government in connection with the flood control program along the Mississippi River. Work was started on Oct. 12 and it was believed at thet time that five months would be necessary to accomplish the work, in view of the fact that 14,000 individual negatives were to be taken and approximately 50,000 mi. flown. However, on Nov. 12 William L. Hamilton, manager of the photographic division, reported thet 8,470 of the 8,900 sq.mi. had been photographed, an average of 282 sq.mi. a day. During thet 30 day period, 13,000 negatives and 130 rolls of special film were exposed in more than 400 hr. of flight. Four aerial survey crews carried out the photography work and the planes used were Curtiss Challenger Robins.

✦ ANOTHER of the conspicuous city-to-city flights by Capt. Frank Hawks—this time between New York and Memphis—brought to public attention a new device for the conservation of fuel. It is known as tha Moto-Vita and is the invention of Dr. Miller Reese Hutchinson. Hawks praised the instrument, and it is reported its use lowers gasoline consumption by more than 20 per cent. [A technical description is included in the Transport and Engineering section.—Ed.]

✦ AT twenty-two minutes past four o'clock on Oct. 31, an attempt was begun to establish what is termed as a world's record non-maintenance flight. At thet time, pilots Leo F. Root and Wallie Hall and Jenkins took the monoplane City of Los Angeles off Rosamond Dry Lake Field, California. The plane was powered with the MacClatchie Panther L-Head 160 hp. engine. The idea of the flight was to prove the endurance and reliability of the equipment, rather than of the men, and the flight was sponsored by J. Warren MacClatchie, president of the MacClatchie Manufacturing Company and developer of the engine. The plane was not to be refueled in the air, but landed every four hours and refueled as fast as possible, with the engine running and an N.A.A. observer on hand to see that the engine was not touched. After each refueling on the ground, tha ship took off immediately to cruise at approximately 75 m.p.h. until the next landing. At 11:10 p.m., Nov. 15, the plane was landed for the last time and the official N.A.A. observer for the flight announced that the power plant had been running continuously for a total of 379 hr. 48 min.

Failing spark plugs were responsible for ending the flight. The plane flew on only six cylinders for the last 12 hr. An immediate inspection of tha engine while it was still running showed that another cylinder had stopped functioning because of spark plug trouble. The remaining five cylinders did not provide sufficient power for safe flying. During the flight the oil was changed eleven times. The plane landed 96 times and spent a total time on the ground of 13 hr. 10 min., each landing and refueling requiring an average of 9 min. 16.3 sec.

✦ THE Kari-Keen Aircraft Corporation, recently acquired by the C. F. Lytle Investment Company of Sioux City, Iowa, will reopen not later then the end of this month. The plant was closed last spring, but experimental manufacturing work to perfect a new Kari-Keen coupe was carried on.

✦ THE Bredouw-Hilliard Aeromotive Corporation of Kansas City, Mo., has contracted for exclusive distribution of Kinner Airplane and Engine Company products in eleven mid western states. The company is already handling Wright products in approximately the same territory.

✦ A PLEA made by the American Eagle Aircraft Corporation to creditors, asked thet they delay legal action and accept non-interest bearing notes maturing Nov. 15, 1931, for debts made by the company. The statement, signed by E. E. Porterfield, Jr., president of tha company, contains a warning of the danger of insolvency provided extension is not forthcoming. He expresses the belief that the company can work out its salvation if allowed another year of grace. Another statement, dated Oct. 22, reports company assets as totaling $250,063. An equity in other assets are sufficient to bring the total to $491,544. Against this there are unsecured claims of only $167,692. In the recent statement, Mr. Porterfield says that his company's total assets exceed total liabilities by a very substantial margin. The thing that tha company lacks is cash.

✦ PLANS are practically completed for the third Miami All American Air Races to be held at tha Miami Municipal Airport on Jan. 8, 9, 10, 1931. The prize fund totals $7,500. There are a total of 24 events. The day following the Miami Races will see the start of the Second Annual All Florida Air Tour, sponsored by the National Aeronautic Association and under the direction of the Florida State Chamber of Commerce, aviation bureau. The tour will start from Miami and visit 25 cities in Florida, ending at Jacksonville on Jan. 25.

✦ THE National Aeronautic Association had made the announcement that the F.A.I. has confirmed as a world's record for Class C airplanes, a speed of 164,432 m.p.h., made by a Ford Transport carrying a payload of 2,000 kilograms (4,409.24 lb.) for 100 km., piloted by Leroy Manning. The plane was a standard stock model, powered with three Wasp engines, without superchargers. One of the main exhibits at the International Aeronautic Exposition, held in Paris Nov. 28 to Dec. 12 was a new high speed tri-engined all-metal club plane exhibited by the Ford Motor Company. The plane was similar in type to Ford Club planes used in America. However, special attention had been given to the interior decoration of the plane. The appointments of the plane carried a note of ultra luxury and comfort.

✦ IN a report recently issued by the Aeronautics Branch of the Department of Commerce on the progress in scheduled air transport operation during the year 1930, is a statement that the Branch investigated a total of 16,012 violations in the period covered by the report. As a result of these investigations, there were 183 assessments of certain penalties, 164 suspensions, 22 revocations of licenses, 7 denials of licenses, 148 reprimands, $3,675 collected in fines, 10 public hearings and 13 cases referred to the Department of Justice. Another interesting item in the report is that of the 13,000 pilots holding Department of Commerce licenses at the close of the fiscal year, approximately 600 were employed on the scheduled air mail and passenger lines. The number of pilots oot employed on scheduled airline operations was close to 100 per cent more than the number ni licensed airplanes on record at the close of the year. The Aeronautics Branch finds that a not undesirable situation. It not only indicates a better market for aircraft but also indicates the existence of a potential market. In the fiscal year 1929-1930, there were 10,360 pilots' licenses issued by tha

Department. That is approximately twice as many as was granted during the preceding fiscal. Licenses renewed during the fiscal year totaled 9,367 and student pilot permits granted totaled 21,191. That represents large increases in both classifications. In addition, there were 39 licenses issued for glider pilots, 3,719 licenses for mechanics and a total of 2,219 mechanics' licenses were renewed.

✦ To those who question the desirability of approved flying schools, the following item should be of interest:

Failures in examination of applicants for Department of Commerce pilots' licenses were less than a fourth as frequent among students of civilian flying schools approved by the Department as among students not enrolled in such schools. At the end of the first six months of 1930, 92.66 per cent of the applicants from approved schools were successful in meeting the requirements for federal licenses. However, only 67.34 per cent of the applicants who did not receive training in an approved school successfully passed the test involved. A check of the records of students enrolled in approved schools revealed that 91.6 per cent actually completed their flying courses and obtained licenses as private, industrial, limited commercial, or transport pilots. The remaining 8.4 per cent include not only those who dropped out voluntarily because of lack of interest or because of financial reasons, but also those who were dropped by the school or who were disapproved for licenses. At present, there are 38 flying schools in the United States holding Department of Commerce approved certificates. The task of rating schools began July 15, 1929. More than half the total number have been approved since the first of 1930.

✦ With reference to the item of a state tax on gasoline consumption, it is interesting to note that airplanes engaged in both schedule and miscellaneous flying operations consumed 12,887,532 gal. of gasoline and 537,212 gal. of oil during 68,669,928 mi. of flying in the first six months of 1930. A total of 6,218,271 gal. of gasoline and 202,249 gal. of oil were used by air transport planes during this period. During the same period a total of 6,669,261 gal. of gasoline and 334,963 gal. of oil were used in 51,767,200 miles of flying by airplanes used in miscellaneous operations.

✦ The new regulations attendant to entry and clearance of foreign aircraft, recently drafted by the customs division of the Treasury Department, following a conference with the officials of the Aeronautics Branch, provide that planes shall report at the airport of entry nearest to the first destination in the United States where a permit may be obtained if the plane is not immediately departing from the country. Under this permit, a foreign plane may proceed at will anywhere in the United States, subject to the prohibition contained in the Air Commerce Act against the transportation of merchandise or passengers for hire between points in this country. The permit has no expiration date but if it has not been surrendered within 30 days, customs authorities will check up on the whereabouts of the plane to determine whether it has been sold or otherwise disposed of and, therefore, subject to duty. The permit is to be surrendered upon leaving the United States at the airport of entry nearest to the point of final destination.

✦ The American Engineering Council has placed itself on record in opposition to the Reed-James Bill to authorize the Army Air Corps to make tests of commercial aircraft and aircraft equipment. Under recommendation of its

Ruth Nichols at the end of her transcontinental flight which fell just one hour short of the flying-time record.

committee on public affairs, the Administrative Board of the Council recently voted to oppose the bill in its present form because it would enable another branch of the government to engage in work that could, with the exception of whirling tests of propellers, be done by private interests. The administrative board rejected an alternative recommendation made by the committee to the effect that the Council should endeavor to have the bill amended so that the Air Corps would be permitted to conduct for private interests only certain types of test for which the Air Corps alone possess the necessary apparatus. No action has been taken on the bill in either Senate or House.

✦ Dr. Louis H. Bauer, medical director of the Aeronautics Branch since its organization, has resigned his post and Dr. Harold Cooper, assistant medical director, has been appointed as his successor. Dr. Eldridge Adams, of San Antonio, Tex., has been appointed to the office formerly held by Dr. Cooper. Although Dr. Bauer submitted his resignation in order that he might engage in private practice, he will not be separated altogether from the medical section of the Department, but will continue as consulting specialist in aviation medicine to the Branch.

✦ Major Floyd Evans has been appointed Director of Aeronautics in the State of Michigan as of Dec. 1, 1930, succeeding Capt. Ray Collins whose resignation was accepted by the Michigan Board of Aeronautics at their regular monthly meeting.

✦ Lieut. Comdr. Fred W. Neilson, U.S.N., resigned, has been appointed sales manager of the Sikorsky Aviation Corporation at Bridgeport, Conn.

✦ The board of directors of the Sikorsky Aviation Corporation, a subsidiary of the United Aircraft and Transport Corporation, has announced that F. B. Rentschler has been elected chairman of the board to succeed A. C. Dickinson.

✦ Edgar N. Gott, president of the Keystone Aircraft Corporation, has announced that George H. Prudden, formerly chief engineer of the Stout Metal Airplane Company and more recently with the Atlanta Aircraft Corporation has been put in charge of all metal design and development at the company's plant in Bristol, Pa. Mr. Gott has also announced the appointment of Stanley W. Jacques, former advertising manager for Curtiss-Wright, to the position of manager of commercial sales in charge of Keystone-Loening Air Yachts and Commuter Amphibions.

✦ Announcement concerning plans for the 1931 Army Air Corps exercises has been made by Assistant Secretary of War, F. Trubbe Davison. Secretary Davison states that dramatic and comprehensive tests to determine the ability of the Army Air Corps to meet a major coast defense emergency will take place

Hawks Eaglet delivered to the Smithsonian. The transcontinental glider joins the institution's collection of aircraft at Washington.

along the northern section of the Atlantic seaboard in May, 1931, when about 500 army planes and approximately 1,100 air corps pilots and enlisted men will be concentrated at New York, Boston, Philadelphia, Baltimore, Wilmington, Washington and other points along the Atlantic seaboard to participate in the annual Army Air Corps field exercises. It will be the first time in the history of American military aviation in time of peace that so many planes will be concentrated for the testing of technical problems over a territory that covers more than 100 sq.mi. in almost a dozen states. It will also be the first time that large scale aircraft exercises have been held on the Atlantic Coast. All tactical squadrons in the United States will be summoned to serve in this major mimic war, as well perhaps, as representatives from the various National Guard squadrons. It is also planned to call a larger number of reserve officers to active duty for the duration of the war, including numerous distinguished pilots no longer in military service who may be willing to take a refresher course. The organization will be known as the First Air Division and will be commanded by Brig. Gen. Benjamin D. Foulois, assistant chief of Air Corps, and will consist of one headquarters group (about 50 planes), one transport group (about 40 planes), three pursuit groups (about 180 planes), one bombardment group (about 40 planes), four provision groups (about 135 planes), to which will be added participating National Guard units and one attack group of about 50 planes. In addition, there will be miscellaneous aircraft, such as radio, photographic and ambulance planes.

✦ The Herbert Schiff Memorial Trophy, awarded annually to the aircraft squadron in the Navy which has shown the most care with regard to safety in flight operation, was presented to the Fighting Plane Squadron 3B, attached to the Aircraft Carrier Lexington, on Dec. 5 by President Hoover. Squadron 3B, beginning July 1, 1929, and ending June 30, 1930, flew a total of 4,958 hr., or about 600,000 mi. The flying was always in formation, most of it over open water. The squadron completed successfully, without the slightest injury to personnel, a total of 861 landings and 861 takeoffs on the Lexington, Saratoga and the Langley.

✦ A recent unofficial statement from the Bureau of Aeronautics is to the effect that construction of the new Navy dirigible "ZRS-4" is progressing at such a rapid rate that completion of the first skeleton is expected by Jan. 1. The huge craft which is being constructed at the Goodyear Zeppelin Company at Akron, Ohio, is the first of two 6,500,000 cu.ft. ships for the Navy.

✦ The Bowlus-Hirth Soaring Schools have been organized in New York City by Hawley Bowlus and Wolf Hirth. Their first school of a proposed chain of 25 or 30 in principal cities, has been established at the Park Central Hotel, and their work was launched with a two-week glider show at the hotels which attracted considerable interest. About 100 are attending the evening ground school classes. Fundamentals of gliding will be taught at the Glenn Curtiss Airport, using the auto-tow method.

AIRLINES AND AIRPORTS

It was announced in November that aggressive preparations were being made for inaugurating a weekly trans-Atlantic air mail service within the next two or three years. Pan American Airways and Imperial Airways of Great Britain, with the French Compagnie Générale Aéropostale to a lesser degree, have been holding preliminary negotiations for joint operation of such a service by way of Bermuda and the Azores.

Additional importance accrued to these reports when it became known: (1) That Maj. G. E. Woods Humphreys of Imperial Airways was in this country for a conference with Pan American officials; (2) that the Post Office Department knew of the negotiations and was prepared to co-operate, and (3) that the Post Office Department would open bids for such a service on Dec. 29.

The airline distance between Charleston, S. C. (mentioned as a likely United States terminal), and Bermuda is about 818 mi. The jump from Bermuda to Flores in the Azores would be about 1,907 mi. long and from there to Lisbon, Portugal, about 1,090 mi.

The maximum rate authorized by law for this class of service is $2 per mile for the specified load not exceeding 300 lb. and $1 per pound per 1,000 mi., or pro rata thereof, for mails in excess of the specified load.

Imperial Airways holds an operating concession in Bermuda, so that an American concern wishing to include the island must have a working arrangement with the English company. For this reason, Pan American seems the most likely candidate for the contract.

✦ It is interesting to note that the reported advance stage of negotiations between Pan American and Imperial Airways was received with some surprise in England. The London *Times* said:

"Imperial Airways stated yesterday (Nov. 14) that there is no question of Atlantic air mail service coming into operation in the near future. There are no machines in existence which could be used for the purpose, and the most that can happen is informal conversation on the matter. The object of Major Humphreys' visit to America is to study American methods in civil aviation."

✦ On Dec. 3, the first Pan American mail plane flying over the new direct route between Miami and Cristobal arrived at the Canal Zone port. The new route is by way of Cienfuegos, Cuba, and Kingston, Jamaica, and replaces the former one by way of Havana and Puerto Cabezas, Nicaragua. The 647 mi. between Kingston and Cristobal were flown with a Consolidated Commodore, twin-engined flying boat which Pan American acquired from the New York, Rio & Buenos Aires line last summer. This is a slightly shorter route and serves Jamaica, as well. Only mail is carried.

✦ The final report of the Fact-Finding Committee on Control of Airplane Hangar Fires by Automatic Application of Water was issued by the Aeronautics Branch early in December. This report includes much more detail than that issued in the late summer and is illustrated with photographs and diagrams.

✦ Thirty visual-type radio range beacons and accessories, at a total cost of $268,453, have been ordered from the Westinghouse Electric & Manufacturing Company for the federal airways.

✦ On Nov. 12, the Post Office Department stated that Pan American Airways reported a great increase in mail poundage carried during the first nine months of this year over the same period in 1929. The company carried this year up to Oct. 1 on all of its lines a total of 168,619 lb. of mail. Last year in the same period the poundage was 45,753. In January, 1929, the poundage was 1,400. This was increased in October of 1929 to 6,515 lb., and to 8,000 lb. in December. In March, 1930, it reached 12,600 lb. and in October of this year, it reached 25,200 lb.

The record of leading divisions was:

In Miami-Canal Zone: March, 1929, 118 lb.; March, 1930, 2,298 lb.; October, 1930, 10,004 lb.

Miami-Dutch Guiana: October, 1929, 1,416 lb.; October, 1930, 3,050 lb.

Canal Zone—Montevideo: October, 1929, 570 lb., October, 1930, 1,740 lb.

Pan American began its full service between Paramaribo and Santos, Brazil

(south of Rio de Janeiro), with a plane leaving Paramaribo on Nov. 27 and Para on Nov. 28. The first south-bound plane reached Rio de Janeiro Nov 30 The Paramaribo-Para section was opened Nov 13 following the improvement of political conditions in Brazil. Service to Pernambuco will be omitted for the present.

✦ Eastern Air Transport extended its New York-Richmond passenger service to Atlanta on Dec. 9-10. It is expected that on or about Jan. 1, the company will inaugurate its Atlanta-Miami-St. Petersburg passenger service, which will give through passenger accommodations over its entire line.

✦ United Aircraft & Transport Corporation opened its long-projected through coast-to-coast passenger service when National Air Transport began carrying passengers between New York and Chicago on Dec. 2. Eight new Fords cover the 730 mi in 6 hr 34 min east-bound and in 8 hr west-bound.

East-bound planes leave Chicago daily at 9 30 a.m., Cleveland at 1 30 p.m., and arrive at Newark Municipal Airport at 4 54 p m. West-bound planes leave Nrwark at 12 noon, Cleveland at 4 46 p.m. West bound planes leave Newark at 12 noon, Cleveland at 4 46 p m , and arrive at Chicago at 7 02 p m The air-rail service between the two citica by way of Cleveland continues.

✦ N.A.T. connects with Boeing Air Transport at Chicago East-bound passengers from the West Coast and intermediate points may arrive in Chicago at 6 p.m. or 6 a.m. and may leave on the 9 30 a m. plane east the next morning or the same day, respectively. West-bound passengers from New York may connect with the 8 p.m. plane west from Chicago or take the 8 a.m plane the next morning

✦ N.A.T. has abandoned the Detroit-Chicago and Chicago-Cleveland services operated for more than two years by Stout Air Service, which N.A.T took over about three months ago It is announced in Detroit that local interests may re-establish these two operations.

✦ The House Appropriations Committee in Congress has recommended allocating $20 000,000 for domestic air mail service during the next fiscal year This is the same sum recommended by the Bureau of Budgets and is an increase of $5,000,000 over the appropriation for last year The domestic air mail carriers received $1,248,766 compensation for the month of September as compared with $1,264,012 for August and $1,269,509 for September, 1930

About 3,300 additional miles of lighted airways have been installed during the fiscal year ending June 30, 1930 Radio communication facilities were installed on about 2,500 additional miles, and radio beacon service on about 1,800 mi. Telegraph circuits now total 5,650 mi

This makes the following total as of June 30: Total lighted airways in operation, about 13,400 mi., intermediate landing fields, 219; airway beacons, 1,477, weather reporting stations, 298; airway radio stations, 45, radio range beacons, 9; point-to-point airway radio stations, 4.

✦ Under the name of Canadian Airways, Ltd , the Dominion's two chief railroad companies, Western Canada Airways, Ltd., and the Aviation Corporation of Canada, have combined to form a comprehensive air transportation system Each railway will subscribe $250,000 of the capital which will total 200,000 shares, no par value. Plans for this combine were first reported several months ago It was assured on Nov 8 One of its first projects will be the development of a trans-Canada airway

✦ An unusually comprehensive report of scheduled airways and miscellaneous flying operations during the first six months of 1930 has been issued by the Aeronautics Branch The totals are

	Scheduled Domestic	Scheduled Foreign	Miscellaneous
Mi. flown	14,595,915	2,306 813	51,767 200
Passengers flown	185 956	22,401	924 800
Express (lb)	1,242,458	3 819	----
Mail (lb)	3,571 936	189 420	----
Mail payments	$4,737 441	$2,217 367	----
Passenger miles	40,319 602	11,290,147	----

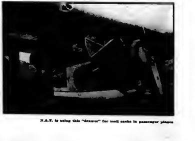
✦ Thompson Aeronautical Corp inaugurated a Detroit-Buffalo passenger service on Nov 11 as part of a proposed Great Lakes transportation system to be developed further next spring Fords are being used at present, but it is planned to substitute amphibions after the winter season

✦ Members of the airport section of the Aeronautical Chamber of Commerce have received first drafts of a proposed uniform basis of airplane storage charges This has been one of the aggravating problems in airport management throughout the country. The charges are to be based on wing span according to nine classes. The suggested rates per class may be varied with the individual airport to meet local conditions. Forty-five dollars a month, or $3 a day, is suggested as a charge for a plane of from 30 to 40 ft. span.

✦ During the three months ending Sept 30, twelve Canadian air mail contractors carried 119,301 lb. of mail, bringing the total for the year up to 379,424 lb Western Canada Airways, operating out of Winnipeg, flew 413,013 mi , carried 5,564 passengers, 316,898 lb. of baggage and express, and 76,572 lb of mail It maintained a 97.4 percentage of regularity on schedule Canadian Airways, Ltd., of Montreal, flew 176,524 mi , and carried 691 passengers.

✦ New York, Philadelphia and Washington Airways Corporation reduced its through round-trip rate from $23.75 to $20, effective Nov 24

✦ Miscellaneous airline news follows: Alabama has ruled that a United States controlled army station is not exempt from the usual state gasoline tax of 4 cents a gallon, the proceeds of which are devoted to highway improvement. . . . Braniff Air Lines opened a Tulsa-Oklahoma City-Wichita Falls (Tex.) passenger service Nov 13, and later extended the line from Tulsa to Kansas City The original Braniff line between Tulsa and Oklahoma City, later taken over by Universal and Southern Air Transport, was discontinued upon the organization of Southern Air Fast Express . . . Two-way radio-telephone communication sets have been installed in every plane of Colonial Division of American Airways between New York and Boston. . . . Effective Dec. 1, Colonial includes Hartford, Conn., as a stop in its Boston-New York passenger line. . . . Pennsylvania Airlines has reduced fares on the Washington-Cleveland service 10 per cent. . . . The Federal airway between Washington and Norfolk has been completed and The Washington-Pittsburgh airway is virtually completed. . . . United States Air Mail Pioneers Association has been organized at Washington, D. C., to include pilots and others closely associated with the early deys of this country's air mail. . . . The passenger service between Newark and Wilkes-Barre, Pa., operated by Frank Martz Coach Company since August, has been extended to Buffalo by way of Elmira, N. Y. Two round trips daily are made as far as Wilkes-Barre and one to Buffalo . . . A radio beacon station is now in operation at Tulsa . . . Bowen Airlines, which has been operating between Houston, Dallas and Fort Worth, later extending to Oklahoma City, now also reaches Tulsa. . . . The Newark Airport has awarded a contract for a $6,900 passenger waiting room in the Colonial Airways hangar. . . . Deed to 23,000 acres of land at Shreveport, La., for the development of a $7,000,000 Third Attack Group base, has been turned over to the Secretary of War . . . Tulsa Municipal Airport is now city property, purchase from private interests having been completed . . . Runways, grading and drainage ditches completed at the Lambert St. Louis Municipal Airport in 1930 cost approximately $50 000



N.A.T. is using this "drawer" for mail sacks in passenger planes

FOREIGN EVENTS

THE country which establishes seadromes, or artificial islands, should be responsible for their management and the planes of no country should be given any special preference, according to a decision made at the recent meeting of the Ninth International Aeronautical Judicial Congress in Budapest. Twenty-two governments were represented.

✦ A leakage of hydrogen gas was responsible for the crash of the R-101, according to the views expressed by Dr Hugo Eckener at the official investigation The chief leakage was in the gas cells in the ship's bow, causing the entire ship to be heavy and the nose to be heaviest of all Dr Eckener believes that the unusually violent movement of the ship in its first dip may have caused an already damaged gas bag to receive a large rent, from which the gas could escape quickly and pass to the tail, making the tail lighter as the nose grew heavier.

✦ The French press has reviewed the position of the French Air Ministry at the close of its second year of existence. Consensus was that many of the hopes reasonably founded two years ago have failed to materialize, and that there are no signs of immediate improvement in many directions. It was granted that the problems confronted by the Air Ministry are difficult, but it is thought they have not been attacked in the right way in a number of instances

France displays her aeronautical wares. This is a general view of the Twelfth Paris aviation salon held in December. In the foreground is the twin-engined Bleriot passenger landplane resembling the Savoia-Marchetti S 55

✦ Discussion of the potentialities of such huge commercial transports as the Junkers G-38 and the Dornier Do X as bombers in time of war caused a stir at the recent meetings of the League of Nations preparatory commission on disarmament.

✦ The Japanese Air Transport Company carried 825 pieces of mail between Dairen, Korea and Japan, during the first ten deys of its nrw one-day service This is a 100 per cent increase over the figures for last year

✦ The Twelfth Aeronautical Salon in Paris, opened early in December, attracted wide interest in Europe, but included comparatively few exhibits outside of French aviation.

✦ The L. E. Gale Company, of Hankow, has announced the sale of six Vought Corsairs and Fairchild planes to the Hunan Provincial Government, and six Wacos to Canton. The Chinese government on Oct. 14 ratified its agreement with Luft Hansa for the operation of mail and passenger services to be started early in 1931 The operating company will be known as the Euro-Asia Aviation Service Promotion of this plan has been delayed by British refusal of permission to fly over India, and objections on the part of Russia; the latter have now been removed.

✦ An international meeting of classification societies for examination of important questions concerning air safety, and for the stipulation of world rules for air material tests and classification of aircraft, was held at Rome on Nov. 3 The United States was represented by Mr Walter Wood Parsons of the American Bureau of Aircraft

✦ The Graf Zeppelin has been deflated at Friedrichshafen for the winter season. During 1930 the airship made 155 flights, covered 144,275 mi , and carried 6,267 passengers and 2,200,000 pieces of mail and freight.

✦ The new Focke-Canard was demonstrated at Tempelhof Airdrome, Berlin, Oct 21. This machine resembles closely the Focke-Wulf flown in 1927, except that the front plane, which by its position, gives the machine the appearance of flying backward, is fixed rather than adjustable to compensate for changing engine speed. It is powered by two Siemens S-H-14 engines of 110 hp.

✦ Miscellaneous foreigo news follows: The noted Italian aeronautical engineer, Enrico Forlanini, died at Milan, Oct 9 . . . Renato Moranti, director of the Transadriatic Aviation Company, and a prominent member of the Italian delegation to the International congress in Washington in the winter of 1928, was killed recently in an airplane accident . . . British Guild of Air Pilots and Air Navigators is advocating removal of secrecy regarding all air accidents. . . . On Nov. 18 the Junkers G-38 terminated a European Tour of 5,625 miles. . . . It is reported in the daily press that an important helium supply has been discovered in the Belgian Congo . . . The Hon. Mrs. Victor Bruce landed at Tokyo in her Blackburn Bluebird biplane on Nov. 14, after a 13,000-mi. solo flight from London, made with a background of less than 100 hr solo experience. . . . Prince George Bibesco, of Roumania, has been elected president of the F.A.I.

WHAT OF THE YEAR TO COME?

By Edward P. Warner

Editor of AVIATION

THE practice of prophecy is somewhat dangerous for the reputation of the prophet, but it is a necessary risk. No plans for next year can be made without some estimate of next year's business. Materials cannot be bought without some sort of a forecast of price levels of the future. Personnel cannot be secured and trained without having in mind the way in which they are to be employed, not only a few months, but several years hence. If no one runs the risk of publishing an estimate of future conditions every business man will make his own, sometimes proceeding from very limited data. So obvious is the need for the intelligent guess at what lies around the corner of the calendar that Babson and Brookmire and Moody and a host of rivals have sprung up to give their attention to prognostication, setting themselves up as the twentieth-century successors of the Delphic oracle of ancient Greece.

Taken as a whole these professional forecasters have given but little attention to aviation, and perhaps they have been wise in so doing, for the problem of anticipating the growth of so novel a business as the building and operation of airplanes is peculiarly difficult. Nevertheless, someone must make the effort, if there is to be any planning at all, and with all these preliminary apologies I address myself to the task. I undertake it in the conviction that a forecast by an individual not directly and actively engaged in aircraft production or operation has a considerable possible advantage over one made by a single industrial group for its own portion of the industry. The future can sometimes be seen most clearly by gaining a little perspective of distance. It is undertaken, also, with a chastened realization of the common fate of prophets, of whose tribulations Grantland Rice once wrote in meditative vein:

"And now, amid the fading embers,
These in the main are my regrets;
When I am right, no one remembers,
When I am wrong, no one forgets."

A considerable proportion of public forecasts are made to prove something or to sell something. They have their place, but I am not undertaking to add to their number. I am taking up the task with the closest approach to complete impartiality that I can command, writing neither as an optimist nor as a pessimist. Obviously, with everyone else in the industry, I shall hope that my estimates are wrong in being too conservative, but I have tried not to be influenced in the slightest degree by that hope. So far as I can guess, the figures given in this study are equally likely to prove above or below the true mark when the year has run its course. It may be observed, however, that the prevailing tendency in the industry has always been to guess too high. Both in 1929 and 1930, I believe that an average of the presumably competent estimates made at the beginning of the season would have given a figure just about double the year's actual production.

So much for introduction. Now to the facts.

Logically, transport and other operations ought to be considered first. Obviously the sale and production of airplanes depends upon the extent to which they are kept in service. When we seek a single measure for the status of the aircraft industry, however, it is still the common rule to use the number of new planes built for commercial purposes. We think of the status of the commercial industry in terms of the production of 1,500 civil airplanes in 1927, 3,500 in 1928, 5,400 in 1929, and about 2,500 in 1930. The first move in prophecy is to attempt to carry that curve forward another point and to forecast the figure for 1931.

This article is a distinct innovation. To offer forecasts as very specific as it contains is an extremely reckless undertaking. It is presented as a personal opinion, based on a great deal of study and some years of practice in making forecasts for private use, and it is deliberately written in the first person singular as a reminder of its personal origin. By the end of the year the author may be looking for sackcloth and ashes, but, for better or worse, he launches his prophecy upon the world, in the belief that even mediocre business forecasts are much better than forecasts as vague as to be meaningless, or no forecasts at all.

1931 Production

IN forecasting production, to go directly to a round number for total output is a futile piece of guesswork. The only intelligent means of estimating is through a breaking up of the market into its several parts, reckoning separately with the demands of individual consumers or groups of consumers of similar interests, and then obtaining a total by summing up the parts. Following that course, I have reckoned separately with prospective requirements of transport lines, schools and taxi services and miscellaneous operators, non-aeronautical corporations using planes for business purposes, and private owners. The study leads to a predicted total of 3,300 non-military planes to be produced in 1931.

Of course any such figure depends on a great number of auxiliary assumptions or forecasts. It depends on legislative action, both federal and state, and upon decisions taken within the executive departments of the government, especially the Department of Commerce. Most of all, however, it depends on general business conditions. In anticipating that 3,300 airplanes will be built I have adopted the presumption, based principally upon financial history and the record of the relation of the relative lengths of bull markets and bear markets of the past, that the present depression will have passed its extreme low sometime in the near future or during the early spring at latest, and that there will be a gradual but by no means a sudden or speedy recovery through the remainder of 1931.

Another point on which I must be clear is that there has been no anticipation of radical innovation in design, but only of normal technical development of the present type of equipment. In setting up these figures no allowance has been made for the effect of the autogyro on the market, as the date on which machines built on that principle will be available for the use of the purchasing public is so very uncertain. It would be quite impossible to forecast the division of business between airplanes and autogyros at the present time.

The total of 3,300 planes estimated to be built includes 400 for transport lines, to be divided approximately 40 per cent for necessary replacements, the remainder for the opening of new lines or for expansion of existing services. It includes 1,400 machines for fixed-base operations, including flying schools. About three-fifths of the total number estimated in that case will be for replacement, with the remainder providing for the highly selective expansion of certain types of operations.

Five hundred planes are expected to be taken by corporations not directly in the aeronautical field. That figure may appear very generous. As a matter of fact, it occasions some qualms on the part of the prophet, but I believe that with even a modest improvement in business conditions it can readily be reached if a specialized sales effort be made. It will demand an energetic effort, nation-wide in scope and long continued, to show business men how the airplane can be used to aid in the economical conduct of their affairs, not merely as an instrument of temporary ballyhoo.

Finally, 1,000 machines are assigned to the private-owner market, using that term in a rather broad sense to include those who make incidental use of their ships in their business. That again is a figure high enough to require some explanation, and again the explanation must lie in a good sales campaign among a class of potential buyers not effectively reached up to the present time. Of the 1,000 planes, I allow for just about one-fifth to be flying boats and amphibions, but the estimate is conditioned on a special effort to sell machines of that class to yachtsmen in particular and to owners of summer homes along the Atlantic and Pacific Coasts and on the Great Lakes, in general.

It will be noted that no separate allowance has been made for export trade, most of the shipments of completed American airplanes being either to Canada, where conditions are essentially as they are in the United States, or to Latin America, where a great proportion of the machines commercially exported are to be operated by companies under American control. The export markets have been cast in with the domestic ones. No separate allowance has been made for purchases by the Department of Commerce and Coast Guard. Both have been lumped in with the fixed-base operators. Figures on sales and production have been used interchangeably, for I believe that in 1931, notwithstanding the fact that a considerable unsold surplus still exists, sales and production will run nearly parallel. In summary:

Transport lines	400
Schools and flying services	1,400
Non-aeronautical corporations	500
Private owners	1,000
Total	3,300

Forecasts of the type of market and of the division among various markets are important as a guide to the localities in which sales effort can be most profitably

expended In planning production schedules, however, it makes no difference whether the plane is to go to an oil company, a transport line, or a private sportsman What is vitally important there is the division of the probable total demand among the various types of equipment.

The most difficult point about an estimate along those lines for the coming year is the introduction of two virtually new types. There is no background of experience from which to predict the popular response to the offering of light single-seater and two-seater planes at $2,000 or less, nor to the almost equally novel introduction of several well-designed and well-promoted light flying boats and amphibions from $5,000 to $7 500. The latter class, to be sure, had made their appearance at the end of 1929, but abnormal business conditions hardly gave an opportunity for fair trial of their attractions during the past year.

Prospects for the Light Plane

There is, I believe, a real market of considerable importance for the light and low-priced landplane, but it is easy to exaggerate its magnitude Consideration of light plane experience in the past and of the general history of the development of the airplane market does not encourage one in the belief that machines of thet class are to come into the hands of the ordinary citizen in great numbers, nor thet they are to do for the airplane industry what the Model-T Ford did for the automobile The great mistake of 1929 was an overestimate of everything connected with aviation. The great mistake of 1930 was an overestimate of the glider's potentialities, with responsible men of long experience in the industry gaily talking as late as the middle of April of the possibility of building and selling 25,000 gliders in the United States during the past year I entertain a very grave personal fear that the great mistake of 1931 is to be a corresponding, although to be sure a less serious, overestimate of the "power glider," or light airplane.

At least 20 types in that general category are under serious development in various parts of the United States, and if all the purely experimental projects were included the number might easily run three times as high. The aggregate of the estimates of production that are being made for light landplanes, excluding from consideration the wholly irresponsible and those without any experience upon which to base their personal forecasts, would be not far from 2,000 machines. My own forecast is that about 500 can be sold, and that the sales will be fairly evenly divided between flying schools and private owners

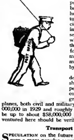
Of the total production of 3,300 planes, then, 500 are allotted to the new light plane class, with approximately 700 more to be contributed by open two and three-seaters of higher power and price The division prophesied among the other groups can best be shown by Table 1.

Perhaps the most surprising features of this classification are the high place given to transport machines from eight to ten-passenger capacity and the generous estimate made for the marine aircraft. The latter has already been remarked upon, and is frankly conditioned on the success of a sales effort that has hardly been undertaken as yet. The former, the generous valuation placed on the probable production of a type of machine of which relatively little has been seen on the transport lines up to the present time, is based on the expectation that there will be a general tendency in transport operations towards more frequent schedules, with a resulting demand for machines of relatively small capacity

Of greater importance than the number of machines built as a measure of the industry's prosperity is the total volume of sales in money units Taking a reasonable average retail price for each type of plane within the above grouping, the total in prospect for 1931 reckons up to $37,800,000 for non-military airplanes and engines, as against a little over $50,000,000 in 1929 and about $20,000,000 during the past year

Military Business

Military production will be smaller in volume than during 1930 Not only have Army and Navy orders for new equipment been placed earlier in the fiscal year (which ends June 30) than is the common practice, with a large part of the purchases for the fiscal year 1931 being made during the calendar year 1930, but there is a substantial cut in the amount of money to be allowed for new purchases during the next fiscal year. The federal budget provides approximately $26,800 000 for new flying equipment for the Army and Navy for the fiscal year beginning July 1 next, as against $30,600,000 for the year now running



Furthermore, competition for military business will be keener than in the past, with a temptation for the contracting officers to seek constantly lower prices and reduction of profits. A considerable number of companies which have heretofore been quite content to pursue a purely commercial market have now been impelled by the depression to seek military orders, and where there were two or three potential competitors for a given class of equipment two years ago there may be a dozen in the field by next summer

Summarizing all this, the decrease in military orders should be more than compensated for by the increased commercial volume and a gross production of complete planes, both civil and military, which amounted to $71,000,000 in 1929 and roughly $45,000,000 this year, will be up to about $58,000,000 in 1931, if the prophecies ventured here should be verified by experience.

Transport Activity

Speculation on the future of air transport is perhaps even a more popular occupation than prophesying the shape of the aircraft production curve Most of the forecasts that I have encountered in the field during a recent tour of the United States have been extremely optimistic, setting the increase in next year's total transport business over that of the present year at anything from 50 to 500 per cent.

The foundation of all prophecy in that area is of course

Table 1: Breakdown of Estimated 1931 Production

Number of Seats	Anticipated Production
Open Cockpit	
1-2, Light or low-powered planes	500
1-3	660
Closed Cabin*	
2-3	450
4-5	550
6-7	380
8-10	160
11-30	165
Flying Boats and Amphibions	
2-3, Low-priced group	140
3-5	130
6-8	105
9-30	40
Total open-cockpit landplanes and float seaplanes	1,160
Total closed-cabin landplanes* and float seaplanes	1,705
Total flying boats and amphibions	414
Grand Total	3,280

*Including transport planes with only the pilot in open.

the amount of money available for air mail compensation Directly or indirectly, most passenger operations have still to lean upon the Post Office. During the past year the aggregate sum has been $15,000,000 for domestic air mail, and $6,600,000 for foreign mail transport For next year, the federal budget provides an increase to $20,000,000 and $7,000,000, respectively, a total just 25 per cent higher than for the present fiscal year Under the terms of the Watres act, assuming the estimates to be enacted into law without change, domestic air mail operations should total about 28,000,000 airplane miles in the fiscal year 1932, or perhaps 26,000 000 for the calendar year At the present time we are running at the rate of 23,600,000 miles per year. The total just mentioned would allow for compensation at an average rate of 72 cents per mile, which seems a fair estimate.

A plane-mile flown with air mail ought on the average to carry with it about four paid passenger-miles by the same operator, whether the passengers actually be carried in the same plane with the mail or on a parallel service The grants made by the Post-Office Department, in addition to compensating the contractors for carrying all the domestic mail sent by air, should insure a paid passenger traffic of about 104,000,000 passenger-miles

The distance to be flown by transport lines without mail affiliations during the year is much harder to estimate At the present time it is at the rate of about 14,500,000 miles a year. I foresee a lower figure for next year, for a number of lines are being operated at a loss in the hope of receiving mail contracts, and will not continue for very long on an independent footing. Only a few have been set in motion with the expectation of continuing indefinitely on passenger business alone. I finally take 11,000,000 miles for the year as the most probable figure for mileage to be flown off the mail routes. Allowing four and a half passengers for each plane on the average, that will contribute another 48,000,000 passenger-miles.

The aggregate paid passenger traffic estimated for domestic air lines for 1931 is then 152,000,000 passenger-miles, as against approximately 85,000,000 for this year, an increase of about 80 per cent All these figures are necessarily very rough, even when they relate to past records, as there are few complete statistics on passenger-mileage, and in particular, there is in most cases no pretense of dividing the traffic between that paid for at full rates and that carried without charge for reasons of company policy

In general policy on transport lines I predict, as already suggested, a general increase in frequency of schedule, along the lines followed on the New York-Philadelphia-Washington service There is likely to be a strong tendency towards smaller planes, ranging in capacity from four to seven paying passengers or the equivalent in mail and express. In estimating a total of 11,000,000 miles for services handling only passenger traffic, I have allowed for the inauguration of at least two or three new short-haul lines, with departures hourly or thereabouts, like the one between New York and Washington, sometime during the year.

A more rapid expansion of transport operations will depend on improved economy of equipment, which will make it possible to carry passengers profitably without dependence on mail contracts. During the past year a fair average of operating costs has been about $0.90 to $1 40 per ton-mile, based on capacity pay loads There is every reason to hope thet it will shortly be brought to around $.50 to $.70 per ton mile under favorable conditions and with schedules frequent enough to keep the overhead within reasonable limits, but the full effects of present efforts for increased economy in design are hardly likely to be shown in the traffic figures until late in the coming year, or even until 1932.

Business should pick up strongly for the fixed-base operators with improvements in general business conditions The statistical background is too slender to permit of giving any specific figures, but I anticipate at least a 40 per cent improvement over 1930.

School Prospects

For flying schools specializing in the production of professional pilots, the coming season promises to be a rather hard one. It is general experience that demand for educational facilities shows a time lag behind the industrial conditions thet produce it. When a profession is overstocked with personnel it commonly takes a year or more for the universities and technical schools to feel the full effect in lessened number of applicants for training in thet particular field On the other hand, students are slow to come forward in adequate numbers to meet the new demands of a growing business A great many transport pilots having been out of work during the past few months, the report is likely gradually to spread that the charms of piloting as a profession have been exaggerated, and some of those who might be enrolling in the schools will hesitate and turn elsewhere.

There should be, on the other hand, a considerable increase in the number of individuals taking up flight training in a small way, merely to acquire an accomplishment, without intending to make it a profession During 1929 there were issued almost exactly 20,000 student permits. For 1930 the figure will apparently be one or two per cent lower. For 1931 I predict 23,000 permits, with 17,000 of the holders getting to the point of taking some sort of formal instruction, but only about 5,000 pursuing regular courses in regular schools in any serious fashion There is likely to be a pronounced increase, with the coming of summer, in the number of those taking casual training by the hour on week-ends or whenever the inclination arises.

1930 PASSES IN REVIEW

WHETHER 1930 be considered as a part of the normal evolution of the aircraft industry to be succeeded by another year not very different, or whether it be regarded as a brief and unhappy episode never to be repeated, we cannot escape a review of its record. Whether next year be like the past one or different, it will be dependent upon it. To review a year is not to write history, but to provide an explanation of the point of departure from which we are taking off for next year's activities. ¶American aviation is much too broad in scope, and its activities too varied, to be summarized as a whole. In the group of articles that follows this page it has been broken down into a dozen sections. Though each is treated separately, they obviously blend with and react upon each other. Though all deserve attention, even from those whose interest in the industry is narrowly specialized, we particularly emphasize the sections bearing on technical progress. Contributions such as those of Messrs. Taylor, Johnson, and Howard and the staff article on the trend of design contain the raw material for charting the course of aerial activities during 1931.

TRENDS OF THE INDUSTRY DURING 1930

By R. Sidney Bowen Jr.
Contributing Editor of AVIATION

A review of what has gone before is a guide for the future. A review of the aeronautical industry during 1930 is unquestionably a guide to 1931, for it was during last year that the industry took the long slide down from an abnormal peak. The accompanying article deals with blunt truths which at first glance may seem discouraging, but when analyzed hold substantial hope for a bright future

AS the twenty-eighth year of heavier-than-air development looms up over the horizon the members of the aeronautical industry are asking themsleves two very definite questions. What has beppened during the past year? Where do we stand now? There are undoubtedly a hundred and one different answers to each question.

The beginniog of 1930 saw the entire industry struggling desperately against the inevitable . . . a continued slump in sales (at once the natural aftermath of a boom period and the natural consequence of general economic conditions) and a consequent slump in production. There were, unfortunately, misguided individuals and organizations who even then clung to the belief thet the late spring and early summer would see marked indications of a speedy return to 1928 and 1929 business levels. As a result their economy programs were far from rigidly enforced. Worse than that, they continued to regard the subject of aeronautical merchandising as something which would be automatically taken care of by the demands of an airminded public.

Distressing as it may be, the very fact thet the United States public was not, and is not, anywhere near 100 per cent airminded was the underlying factor in the failure of more than one aeronautical venture during the year of 1930. The general business depression which swept the entire world had its dire effect on the industry of aeronautics. However, it is firmly believed that even though general business had been at normal levels it would have made only a secondary difference in the aviation outlook, the sort of thing that beppened would have beppened anyway, although to less serious degree. Of course, the purse strings of the banks and other financial institutions would have been loosened a bit more. But when viewed from another angle it is a good thing that they were not. Funds were the least of the industry's needs.

To be more explicit regarding the continued depression of the industry during 1930 we go back to 1927 . . . the year when the man-in-the-street really began to take notice of the feats of the airplane. At regular intervals the world goes crazy about something. In 1927 it picked on the airplane. The events that followed thet hectic year are well known. They need not be recorded in detail in this article. However, what did happen has had a very pronounced and discouraging effect on the aircraft industry. After an over-night rise to boom times, and the formation of a sincere belief that an industrial millennium was at hand, the aeronautical industry has slid down the other side of the hill to a point which at first glance appears to be the lowest possible level. It was during 1930 that the industry took the last long slide. As one aeronautical authority has expressed it . . . "Anything that happens from now on is bound to be an improvement."

Such a statement might be taken as the bemoaning of one who has thrown up his hands in despair and expects the worst, so that, at least, he will not be disappointed. On the contrary, if that statement be true, and we certainly believe that it is, it signifies a lot that is encouraging. It means that all the false beliefs have been replaced by sound reasoning. It means that the cart is no longer before the horse. It means that the hindering rabble that followed a gold rush have been dropped by the wayside. It means thet the industry has come down out of the clouds and is now on a solid foundation where development keeps pace with demand.

FROM the standpoint of production and sales the industry began the year of 1930 with a great handicap in the form of a large carryover of 1929 stock, and a rapidly declining market for any type of production, new or old. During the winter months of 1929-30 there was considerable talk about plans for clearing the shelves during the early part of 1930. For a time, sales organizations, from the factory sales manager right down to the lowest sub-dealer, were all keyed up to go out and virtually throttle the market. Of course there was also considerable activity on the drafting board, but in general it consisted mainly of refinements of existing models. A company with a large unsold stock on hand has very little incentive for attempting innovations so radical that they will make the existing equipment obsolete and unsalable.

The first real concentrated sales drive by the manufacturers took place at the International Aircraft Exposition held at St. Louis in February. There the exhibitors

strove desperately to unload 1929 stock and still interest their limited markets in 1930 equipment The efforts, valiant as they were, were not even encouraging. The main reason for the merchandising failure at St Louis was the very obvious fact that the manufacturers' sales outlets, the distributors and dealers, were themselves loaded up with 1929 stock.

The same thing happened at the All-American Aircraft Show in Detroit two months later. If there was any difference it was that the sales managers had become even more disheartened and did not bother to exert maximum sales effort Those who attended that particular aircraft exhibit will recall the apparent disregard that the exhibitors had for each and every one who chanced to stop and inspect their displays Even so, the sales record was better than at St Louis

The failure of the industry to build up sales volume during the first half of the year can be attributed to the fact that the profitable market of other years, the industry itself, was over-supplied with equipment The only other outlets for the airplane, namely the private and business markets, were hit-or-miss ventures Up to 1930 there had been little concentrated and persistent effort directed at those two markets For a time it did appear that they were being successfully invaded However, it later proved that many of the sales supposed to be going to those two markets were really sales to the members of the industry itself

Included in the plans for a 1930 selling drive were plans for opening up the private market. The results were negligible In justice to a few organizations which really did hammer at the privete door it must be admitted that some few sales were made, but the total volume is hardly worth mention

Of the various ways in which the private market was attacked the one most widely heralded was the idea of a small, low-powered plane, selling at a low price and possible of operation at a low cost A few examples of that type appeared on the market Accounts of their accomplishments got onto the front pages of the newspapers However, their reception by the general public has not as yet been whet one might term encouraging

Some other mannfacturers hit upon the ides of the glider as the solution to the decrease in powered plane sales They convinced themselves (and even their boards of directors) that the glider was unquestionably the first step toward powered plane operation. They maintained that thousands who did not heve the price of a powered plane would spend what they did have for a glider. After that they would graduate to the power glider. And after that . . . eureka, a powered plane sale!

The buldness with which some of the manufacturers leaped upon the glider idea was almost inconceivable Without even feeling out the market, they went right into a production schedule. In one or two cases all production of powered planes was stopped, and all hands concentrated on manufacturing the glider For a time it looked as though there would have to be more regulation governing primary glider construction and operation than that of powered planes. The results of all that activity were inevitable. There were a certain number of gliders sold. However, production soon exceeded demand and today there are gliders on the shelf and unsalable.

In the efforts expended to enter the private market, the Government lent its aid though regulation intended to impress the public with the safety of flying. For example, flying schools were rated according to equipment and personnel. In such schools the quality and quantity of instruction given was government regulated Toward the end of the year the Aeronautics Branch took a very definite step toward belping the sale of private planes It adopted the policy of permitting prospective purchasers of approved type aircraft and prospective students of approved flying schools to handle the controls of aircraft during demonstration flights without getting student permits. However, the policy was not adopted until late in the year. Its benefits did not apply in 1930 That change in regulation resulted from a discussion between tha representatives of the Department of Commerce and the aircraft manufacturers at Washington in September. The meeting of the industry with the Department was more successful than any of its predecessors, thanks to a careful preliminary analysis of the subject matter Under the auspices of the Aeronautical Chamber of Commerce, the manufacturers canvassed the ground for two days and prepared a clear expression of their collective sentiment to present to the Department.

By the time summer arrived, a certain amount of 1929 stock had been removed from the shelf, and some of the 1930 production had also found a market Strange as it may seem, sales started to fall off in the months of June, July and August, the three months that offer the most perfect flying weather the country over Some manufacturers were faced with the possibility of ending the year loaded up with both 1929 and 1930 stock Sales forces were reduced to a minimum The enrollment in the "Aeronautical Alumni Association" reached figures that were staggering even to the blasé At the first of the year there had been faint signs of a price war. During the summer it became a price slaughter. Equipment began to move off the shelf at figures below manufacturing cost Of enurse it must be understood that the above does not mean that every manufacturer took what he could get and was glad of it, but many did. The production left over from 1929 was virtually sold to the highest bidder. Although it is impossible to get the true figures, we feel safe in estimating that the 1929 equipment which changed hands during 1930 was sold at a price which averaged less than 75 per cent of the 1929 retail price.

The merchandising story for the last third of 1930 was no different except that there was a slight increase in sales Official figures on production for the entire year are not available at this time, but commercial production for 1930 was more than 50 per cent below production for 1929 Although there will not be such quantities of 1930 stock carried over into 1931 as there were carried over to 1930 from 1929, there are still a number of planes of the 1929 vintage resting on the manufacturer's shelves, and the shelves of his sales outlets

The export picture for 1930 is much brighter than the domestic one. A particularly complete account is contained elsewhere in this issue, so we limit our remarks to the statement that while plane sales were less than the 1929 period the gross value figure was nearly the same Our export markets have been absorbing less planes at a greater price per unit and their relative importance, compared with the domestic sales, has been steadily increasing Accessory and parts sales to foreign countries were very steady during the year It is quite possible that the final figures will show an increase in gross value over 1929

Returning to the domestic situation during 1930, reference is made to the statement at the beginning of

this article which was to the effect that the beginning of the year saw several manufacturers convinced that the country was airminded. Because of that belief, and the intense desire to clean house on the part of others, real intensive market research and analysis once again became a matter of secondary importance. From the standpoint of design, history was repeated. Of course, there were improvements and refinements of design. However, the regular practice continued to be first to make a product and then to order the selling department to go out and find and develop a market, or markets, for that product It is impossible to estimate the amount of time and money which would have been saved during the year if manufacturers had universally adopted the policy of first finding a potential market, estimating its requirements, and then setting about the task of producing a plane to meet them. John Doe is *not* going to buy an airplane at any price until he can get the type of airplane he wants.

There are those, of enurse, who will rise at this point to remark that Joho Doe does not know what he wants. That is quite possible Nine out of every ten John Does cannot now afford the time nor the money that go with flying, nor do they want to be bothered with all the red tape attached to the activities of a beginner. To assume thet thet will always be the case, however, would be far too pessimistic. In due course, conditions will be quite changed Those who insist upon a reason for that cheery conclusion are referred to the history of the automobile.

Regardless of all thet, it was proved quite conclusively during 1930 that even a development which fires the world as did the airplane cannot be forced into general use over a period of one or two years, or even three years for that matter. Public demand for a product is created only by educating the public as to its advantages It grows with experience But even before that is attempted the needs of the prospective market should be determined.

In summing up the production and sales situation it can be stated that 1931 finds the industry right down to hardpan. The great hopes for sky-rocketing sales volume have been definitely dropped That in the final analysis is exceedingly encouraging, for now even the most optimistic manufacturer will exert all of his efforts toward giving his market a product which it needs and wants instead of plowing ahead blindly in the endeavor to find markets for whatever he has to offer.

As THE aeronautical industry is composed of two units, manufacturing and operation, a review of activity trends during the year would naturally be incomplete without some comment on the operation phase Printed elsewhere in this issue is an account of air transport development during 1930 Therefore what follows will deal with transport only from the merchandising angle.

Unlike production and sales, air transport operation during 1930 gained in every phase. Lines that beld mail contracts were in the black ink for the year, or else very close to it Passenger lines did not do so well. However, the year saw a general reorganization, as the result of legislation, which in time will probably prove most beneficial The year of 1930 saw also a marked decrease in the fatality rate.

That one item will heve a greater effect upon the non-aeronautical public than all kinds of figures about lines inaugurated, pounds of mail and express carried, and miles flown. Incidentally, air transport operation will have an effect all its own on the development of a private and a business market for planes. Trite as it may be, it is nevertheless true that no one ever bought an airplane before he flew in one. The more patronage the airlines receive, the greater will be the prospective market for individually owned planes.

Although it was proved to a certain extent that fare and not fear was keeping people on the ground, uneasiness does play a big part. The lower the accident rate, the more impressed will be those who seriously consider traveling by air.

If there was a turning point in air transport operation during 1930 it was in April when the Watres Bill was passed and written into the statutes. Up to that time, passenger lines had been fighting what seemed to be a losing battle against operation loss. The fares were too high to permit full-load operation, and when they were reduced the passengers came forward but were carried at a loss. Success in air transport operation depended on whether or not one held a mail contract.

The Watres Bill was introduced with the idea of benefiting air transport by giving every important line a business chance of making profit Shortly following its passing it began to be interpreted in diverse ways by the Post-Office and the Controller General, and some of the rulings handed down proved most unwelcome news to certain companies Even at this time the exact meaning of the Act is not clear to all As a result some operators are rather hesitant about laying out additional capital to develop their lines Experience, however, will straighten out the various misunderstandings that are continually popping up, and the main purpose of the Act, the benefiting of air transport, will be fullfilled

The Watres Act has had a most pronounced effect upon the airline merger situstion During last year three main trunk lines were developed to serve the country through coast-to-coast operation

Those three trunk lines were direct results of the passing of the Watres Bill. Whether or not the verious companies composing them would have merged regardless of the Act is open to considerable argument. However, the fact remains that the workings of the new law left them little alternative. Every one of the individual companies involved has had experience. Several of them have been operating successfully for a number of years With such a background it is practically a foregone conclusion that future progress will be made at a rapid and profitable rate. And, as already suggested, the progress of air transport in this country will have a very direct effect on the progress of aircraft merchandising The time is coming when the non-aeronautical market for planes will be very profitable to the manufacturer. However, the airline is the backbone of the aeronautical industry, and upon it rests a great part of the success or failure of the industry's various branches.

To SUM up briefly the answer to our second question: Where do we stand now? it can be stated that the industry stands on solid ground facing a terrific task Thet that task will be successfully completed is inevitable. It will, for it is nothing new. Other new industries heve been faced with essentially the same task, although none has ever had it presented in a more difficult wey. They heve done their job. It is for us in aviation to guard against making the same mistakes over and over again We sincerely believe that the industry has stopped that sort of thing already. The lessons of 1930, bitter as they were, really were a help. At least the rose-tinted glasses have been removed and the industry is seeing the light of day, some of its members for the first time.

AIR TRANSPORT PROGRESS

Loading mail on Transcontinental and Western Air plane at Los Angeles Terminal.

IN SPITE of the fact that practically every air transport operator in the United States operated at a loss during 1930, unless supported by mail contracts, the development of air transportation has made its greatest strides toward stability during the past twelve months The actual numerical gain over the previous year in miles flown and passengers carried was greater during 1930 than ever before Furthermore, air transport was in the act of being established during 1929, and though the immediate public patronage was gratifying, there was no assurance that it would be permanent The continued growth of traffic during 1930 has given us adequate proof that the air transport systems are hare to stay.

Air transport development during 1929 was characterized by feverish activity, much meaningless clamor, a great deal of experimenting with rates, routes and schedules, and some destructive competition During 1930 this somewhat jumbled picture was clarified in a number of ways Mergers united many small firms and some large ones to such an extent that we enter 1931 with about 90 per cent of our air transport operations in the hands of four large groups Rates have stopped oscillating and are now almost universally at about six to eight cents a mile, a little above the level of de luxe train fare All major trunk-line routes immediately needed are in operation now, with three transcontinental services and four major north and south lines intersecting these three. The framework of American air transport service has been established, and most new routes started will serve as feeders to these trunk lines or as purely local developments. Some measure of tha pace at which passenger air transport is being developed is given by the direct comparison of transcontinental schedules During 1929 the eatablishment of a 48-hr. coast-to-coast passenger service was hailed as revolutionary, yet the time was reduced to 36 hours with the inauguration of the central route by Transcontinental and Western Air, Inc, late in 1930, and this will be lowered to approximately 24 hours with the advent of night flying on this route, planned for the coming year

Continuance of low fares has halped to boost traffic totals during 1930, but the operators have taken heavy losses on their passenger operations. Under the provisions of the Watres bill, passed and put in operation during 1930, mail subventions have been extended to a few passenger lines and all of the major air transport systems are now partially supported by mail contracts. At the same time costs of operation are being pared in many ways To supplement passengers and mail, there is a hope of heavy aerial express traffic within the next eighteen months as a result of co-ordination between all operators and lowered rates Thus, while operators are now in the midst of a stiff winter and are still taking staggering losses on the operation of some lines, the general prospects for the future of American air transport were never brighter than at present.

ENACTMENT of the Watres bill by Congress was the outstanding factor in air transport development during 1930 Its provisions made direct financial aid available to passenger lines during a most trying period, and assured tha continuance and expansion of the major air passenger services As a result of this measure approximately 9,000 mi of mail routes were added to the air map, with an increase of 35,000 mi flown per day with mail Two new transcontinental routes were inaugurated A number of advantageous mergers were consummated and the pay schedule on all air mail routes was placed on a more equitable basis The formula under the provisions of the Watres bill provides for rates of from 55 cents per mile where a weight space of 200 lb or 12 5 cu ft is provided, to 95 cents per mile where planes capable of carrying 2,000 lb or 125 cu.ft.

of mail are operated. There are additional variable amounts granted for various types of flying, such as at night or over rugged country, and for extra passenger capacity, bringing the absolute maximum up to $1.25 per mile. On all new routes, space for passengers must be provided.

Operators subsidized by mail contracts are making every effort to expand the strictly commercial phases of their operations. It is generally understood, and properly so, that air mail contracts, as now administered, are the government's contribution to air transport development during the lean period of establishment It is to be expected that air mail will play a constantly less important rôle in air transport operations after 1931

Several mergers were a direct result of the passage of the Watres bill. Most prominent of these was the operating agreement of T.A.T.-Maddux with Western Air Express, Inc., to form Transcontinental and Western Air, Inc., for the purpose of operating the central mail route from New York to Los Angeles. Next was the merger of Southwest Air Fast Express, Robertson Air Lines, and Standard Air Lines under the banner of American Airways to form Southern Air Fast Express and operate the southern mail route from Atlanta to Los Angeles. Earlier in the year National Air Transport had been acquired by United Aircraft and Transport Corporation, in order to set up a coast-to-coast service which would profit more fully by the anticipated passage of the Watres bill Later Stout Air Lines was combined with N.A.T., and Varney Airlines, carrying mail between Seattle, Portland, Spokane and Salt Lake City, was taken over by Boeing Air Transport to give United one of the most closely knit air mail and passenger systems in the country.

Earlier in the year the Aviation Corporation completed the assembly of the lines that it controlled, under the name of American Airways Those merged were Alaska Airways, Colonial Airways, Colonial Western, Canadian Colonial, Interstate Airlines, Robertson Aircraft Company, Southern Air Transport, and Universal Aviation Corporation.

In August, the purchase of NYRBA by Pan American Airways was approved by the Department of Commerce and postal authorities, and the two lines were consolidated Marked economies resulted and the new system, with 131 planes, is the largest in point of equipment and in length of routes operated by United States interests.

Of special significance was tha success of short-haul airlines established during 1930 Gorst Air Transport, operating a Seattle-Bremerton air ferry across 12 mi of water, reported 2,700 trips and 25,000 passengers carried in the first year of operations, which ended in June, 1930. Air Ferries, Ltd., started a 6-mile air ferry service across San Francisco Bay in February, 1930, and carried more than 60,000 passengers during the first nine months New York-Philadelphia-Washington Airways started operations between the cities named on Sept. 1, 1930, with an every-hour-on-the-hour schedule and carried 1,557 passengers during the first ten days Traffic held up to an average of 1,050 passengers per week through October, and this line has the distinction of being the most heavily traveled airline in the world. Several factors in the operation of the Ludington line, as the service is generally known, are of interest and are outlined elsewhere in this issue.

Such figures as those make it evident that there are real possibilities in the short-haul airline, and that striking economies may be effected without sacrificing either patronage or safety The widespread application of more frequent schedules, with every effort for economy, is to be looked for in several sections of the country during 1931

Another significant feature of 1930 in air transport was the maintenance of fares at comparatively low levels After dropping during the latter part of 1929 and early 1930 to as low as 5 cents per mile from a previous average of 10 to 15 cents per mile fares averaged up about 40 per cent and have gone on higher The present levels seem to be hare to stay, and operators must look to the development of mail, express, and freight loads and to further operating economies for further profits. With rail service as good as it is in this country, there is little prospect of air travel in considerable volume at fares much above limited train rates

A NUMERICAL comparison of 1930 with the previous year shows marked progress in every phase of transport flying The total number of operators listed by the Department of Commerce increased from 35 at the first of the year to 48 by Nov 1 Total of all routes increased from 79 to 112 during the same period There were 38 new routes started in 1930, several established routes being discontinued due to mergers Of the 38 new

Pilot collecting tickets on "one-man" planes of the Ludington Line.

routes, 32 were devoted to carrying passengers and express only, two to mail only, and four carried passengers, mail, and express. The tendency toward passenger and express carrying is further shown by the fact that 80 per cent of the routes operated in November, 1930, were carrying passengers as against but 72 per cent in December, 1929. The number of routes handling mail increased from 39 at the close of 1929, to 45 at the close of 1930, but the percentage of lines carrying mail dropped from 49.3 per cent in 1929 to but 40 per cent in 1930.

The tendency toward more frequent schedules is shown by the fact that the average round trips per day over scheduled air routes increased from 2.3 in 1929 to 3.6 in 1930. While total domestic routes increased from 72 to 112, those operating at least twice daily increased from 19 to 30, those operating more than twice daily from five to eleven. Total daily trips of lines operating more than twice daily increased from 23 to 80. With most of our major air transport routes now established, it is to more frequent schedules over these routes, and to the development of feeder lines, that we must look for progress during 1931.

Total mileage of established airways was 47,184 at the close of 1930 as against 36,330 in 1929 and 16,667 in 1928. Total miles scheduled daily increased to 123,771 in 1930, compared to 87,684 in 1929 and 39,060 in 1928. Mail loads increased about 10 per cent in the first six months of 1930 over the same period for 1929, and express loads more than 16 per cent. Total miles flown were about 43,000,000 for 1930, as compared to 25,000,000 in 1929 and 10,000,000 in 1928. Although no exact figures are available on total passengers, Department of Commerce reports indicate 208,357 passengers over scheduled routes during the first six months of 1930. It is probably safe to say that the total number of passengers carried by transport lines during 1930 was more than 400,000, and that the total passenger miles flown approximated 100,000,000. This compares with approximately 150,000 passengers carried in 1929 and an estimate of 48,000,000 passenger miles flown. From January to June, 1930, the number of transport planes in domestic use increased from 250 to 315, and the hours per month flown by each tri-engined plane increased from 56.1 to 95.6. Safety, with special reference to the elimination of chance-taking on the weather, received more attention in 1930 than ever before.

During 1930 almost innumerable improvements, both major and minor, were made in ground and flying equipment. Trends in flying equipment were shown by the commercial application of the Fokker F-32, 30-passenger airplane, the development of the new high-speed Ford, the low-priced Stinson 8-passenger airliner, the Boeing monomail single-engined low-wing monoplane of one-ton capacity and the Sikorsky 16-passenger amphibion. Development of the Dornier DO-X and the Junkers G-38 in Germany was interesting. The trend in flying equipment is toward lower-priced planes. Several of the largest manufacturers announced substantial reductions in price during the year. At the moment, there seems to be a trend back toward single-engined planes, and the urge for giant airplanes has subsided.

Of major interest is the number of flight accessories introduced during the year, and calculated to improve efficiency or safety. Navigational aids tested or applied include the Sperry gyro-pilot, Sperry artificial horizon, Guardianaire wind-vane pilot, visual radio range equipment, and the Deviometer for flying a radio range course off the path of the beacon. These aids, coupled with improved ground communications provided by teletype extensions, enlarged weather reporting service, and perfected two-way ground-to-plane radio voice systems have done much to lessen weather as a factor, and will do more during 1931 as the use of new equipment and new instruments becomes more general.

Other general equipment developed and of importance to transport operation includes mail-bag pick-up devices, fire-proof mail bags, application of the Townend ring to transport planes, perfection of variable pitch propellers which will soon see commercial use, the Henrickson device which warns the pilot when ice may start to form, and the ice overshoes developed by Dr. William C. Geer which prevent the formation of ice on wings.

Ground equipment of importance consisted chiefly of installation of radio range stations by the Department of Commerce, organization of aircraft radio communications into a system of five chains controlled by Aeronautical Radio, Inc., co-operatively controlled by the major operators, and the extension of teletype services with the result that cancellations of service were decreased as much as 30 per cent on some routes.

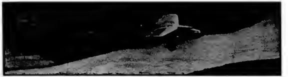
Air traffic control systems are also being tried in many parts of the country, and it will soon be necessary to co-ordinate types of signals used, but few steps in this direction have been taken as yet. Air traffic is being controlled at the present time by means of flags, lights, steam jets, lighted panels, radio, the use of separate runways for landing and taking off, and by other methods. The fact that London has prohibited flying over the city at any time or any altitude, and that Paris has prohibited all flights over the city during the hours of darkness, should indicate to American operators the desirability of working out air traffic control systems at an early date in order to avoid unfavorable legislation wherever possible.

Much study was devoted during 1930 to methods of making the passenger comfortable while flying, and little is left now except to eliminate noise in aircraft. Noise has been extremely bothersome, and little scientific attention has been given to it by the aircraft builders themselves, but laboratory experiments conducted by the Department of Commerce indicate that most of the objectionable noise can be eliminated.

Transport terminals have developed rapidly during 1930 and are now very nearly ideal, or at least as good as can be expected for a long while to come, in most western and a few eastern cities.

Aircraft engines have been improved rapidly, and there is a strong tendency to gain further power by using special high-test fuels.

The future of the transport pilot has been one of the hotly debated questions within the industry during the past year. There has been much discussion of taking responsibility from the pilot as a result of the perfection of two-way voice communication and the perfection of weather reporting and inter-depot ground communications, reducing his position from one comparable to that of the captain of an ocean-going vessel, in full command of his ship while on the high seas, to one about midway between that of the ship captain and the railroad engineer, who constantly receives orders en route. It is probable that there will be a general drop in pilots' salaries to a level somewhat lower than that now in



Transcontinental and Western Air Fokker F-32 flying over Colorado River.

force, and it has already come in several instances.

It is quite possible that trans-oceanic airship lines will be established within the next two or three years and that they will prove a real factor in promoting all forms of air travel. It seems more probable, however, that trans-oceanic services will first be attempted by seaplanes or amphibions. Plans are now being formulated for the establishment of such a service by American and British interests, to operate across the North Atlantic via Bermuda and the Azores, and both governments have indicated that air mail contracts would be granted.

A month-by-month chronology of air transport development during 1930 is of interest. During January the American Air Transport Association met in Chicago and took steps to synchronize all airline schedules, to arrange for exchange of passengers, standard ticket forms and co-operative ticket selling; air mail rates to South and Central America were reduced; T.A.T.-Maddux reduced the N.Y.-L.A. fare to $159.92 from $267.42; Pan American-Grace Airways opened its Cristobal-Peru route to passengers; Postmaster General Walter F. Brown proposed the law amendment which was later enacted as the Watres Bill; the Department of Commerce enacted the minimum altitude of 500 ft. for transport planes.

During February, Air Ferries, Ltd., started operating across San Francisco Bay and carried 10,000 passengers in the first month.

In March, T.A.T.-Maddux reported a net deficit for 1929 of $986,591; United Aircraft and Transport started a fight for the control of N.A.T.; Western Air Express ordered $200,000 worth of Western Electric radio equipment for two-way voice communication between earth and plane.

April saw United Aircraft and Transport gain control of N.A.T. and the valuable mail contracts held by the latter; this gave U. A. & T. the first complete coast-to-coast line under one company; the Watres Bill was passed by Congress; W. A. E. started operating Fokker F-32's on the Los Angeles-San Francisco run.

In May, Aeronautical Radio, Inc., was formed to take over administration of airline radio communication for 60 per cent of all air lines; the Department of Commerce started enforcing airline regulation rules which require inspection by the Department and granting of a certificate of authority to each transport operator for each line; Postmaster General Brown announced a formula for pay to air mail route operators under the Watres Bill.

Slight passenger fare increases were made by T.A.T.-Maddux, S.A.F.E., and American Airways during June; P.A.A. made an extension from Paramaribo to Rio de Janeiro.

United acquired Varney Air Lines during July; N.A.T. accepted the Johns-Manville fireproof mail bag; Department of Commerce announced details of air transport certificate of authority plan in tentative draft form.

During August, Pan American Airways bought the New York, Rio de Janeiro, and Buenos Aires airline, and merged both services, with a total of 131 planes; eastern Air Transport started daily passenger service between New York-Philadelphia-Baltimore-Washington-Richmond; lines were suspended by S.A.T. and Universal between Tulsa-St. Louis, and Houston-San Antonio.

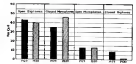
September 1 saw the start of New York-Philadelphia-Washington Airways, with an hourly service from 8:00 a.m. to 5:00 p.m. over a 200-mi. route at a fare of $14.70 each way; N.A.T. bought Stout Air Lines and merged with the passenger service in prospect between New York and Chicago; Aviation Corporation and S.A.F.E. won the southern route mail contract; T.A.T.-Maddux and Western Air Express won award of central air mail route and formed Transcontinental and Western Air, Inc., to operate the new line; Nebraska, Utah and Oklahoma granted airlines exemption from gasoline tax.

During October the R-101 was lost; the Department of Commerce successfully tested its Deviometer for use in connection with radio range stations; S.A.F.E. suspended as result of merger with American Airways; T. & W. A., Inc., started 36-hr. mail and passenger service from Los Angeles to New York over the Central route; N.A.T. started Chicago-Cleveland passenger and express service; Ford freight lines carried their 10,000,000th pound of freight over Detroit-Chicago, Detroit-Buffalo lines in five years, now carrying 3,000,000 lb. per year.

In November, Eastern Air Transport, extended passenger service to Atlanta under provisions of Watres bill to meet Southern Air Fast Express and complete the southern mail and passenger route from Los Angeles to all Atlantic Coast cities; transatlantic air mail line was proposed by American and British interests.

Taking all factors into consideration, the progress made in air transport during 1930 is most impressive. The possibilities for future profit loom larger with each passing month. Cheaper, more efficient, and more economical flying equipment gives promise of materially lower costs of operation in the near future, as do also the many improvements in method of operation which are being worked out.

1930 AIRPLANE DESIGN



Comparison of the proportion of approvals of standard types for 1929 and 1930

ONE of the most encouraging indications in the airplane design progress of 1930 is the fact that this branch of engineering is becoming more closely identified with economics. This applies particularly to transport machines, where payload and performance are being increased while power remains constant. Virtually all of the performance gains, therefore, have been accomplished by aerodynamic refinement and decreased structural weight, and wasted energy has been put to useful purpose.

A period of leisurely production has been conducive to meditation on the part of the aeronautical engineering profession, and has given its members an opportunity to recall certain fundamental principles of all engineering. Probably the most important of these is the basic truth that careful and painstaking design work is the best possible method of obtaining performance progress and that there is no short cut to this end.

There is another phase of aeronautical engineering that has not gained very great impetus despite the fact that engineers have had the benefit of a long period for leisurely reflection. This is the maintenance feature of aircraft design. While it is in general undesirable to draw analogies with the automotive field, it is probably justifiable in this case to call attention to the fact that many automotive engineering projects have stood or fallen because of no other feature than the matter of maintenance. In justice to the aeronautical engineer, it must be stated that occasionally one finds a design in which considerable thought has been given to maintenance problems, but this is the exceptional case. Much more often one finds that the engineering staff has done a very creditable piece of work in the actual designing, but has forgotten the fact that the purchaser may some day desire to service or repair his airplane.

While the aerodynamic refinement and maintenance phases of aircraft design are both directly traceable to the economic motif, which has characterized the airplane designs of the year, these two elements are frequently inclined to work against each other and it is often necessary to effect a compromise, the effectiveness of which is only measurable in economic terms. There have been a number of examples of this, particularly in the development of radial engine cowling during the past year. The first commercial cowling of the N.A.C.A. type produced a very high degree of aerodynamic efficiency but it was soon found that maintenance problems would have to be considered. The tendency of the year has been toward the simplification of these cowlings and the N.A.C.A. has taken an important part in the development of cowlings, perhaps less efficient aerodynamically than the first, but considerably more desirable from the cooling and servicing standpoints. The result of this has been a cowling of the simple ring type, adapted from British ideas, which is quickly detachable, with highly desirable visibility features, and which in no way interferes with the normal cooling of the engine.

A similar condition has existed in the development of such units as wheel fairings. The first of these were designed to obtain aerodynamic refinements without thought of any other factor, but it was soon discovered that the best of airplane wheels must occasionally be serviced and some of the aerodynamic gain had to be sacrificed to obtain a quickly detachable feature.

This general principal might be carried to virtually every unit in the construction of an airplane and, despite the fact that it is our function to review rather than prognosticate, we venture the prediction that next year's engineering, will show advances in the maintenance feature of airplane design.

The year has seen a number of achievements in the aerodynamic and structural fields and much pioneering and original research has been done in both. Considering first the aerodynamic aspect, one may divide the year's progress into two general phases; one the tendency toward more efficient design, and the other pioneering work in new and promising developments. The second of the above mentioned groups is not to be confused with the vast category of absurdly impossible ideas that has been exploited by unscrupulous stock salesmen during a period which might be characterized as the regime of high pressure salesmanship. Considering the more conventional group of high aerodynamic refinements which incidentally go hand and hand with beauty in appearance, we have such airplanes as the Lockheed Sirius; Boeing Monomail; Verville, Howard, which distinguished itself during the National Air Races, and a number of others. This group reflects the highest attainment thus far in cleanliness of design and is characterized by such features as tapered wings, retractable landing gears, engine cowling, wheel fairing, and ample fillets.

Development of retractable landing gears for machines other than amphibions has been one of the notable advances made by this group during the year. This tendency may be traced to certain N.A.C.A. research on the drag of the separate parts of a typical airplane and the resulting realization of the tremendous sacrifices necessary when one must carry a protuberance as large as the landing gear.

Th landing gear problem suggests an interesting digression on the subject of air versus ground operations of airplanes, but space limitations prevent discussion of this important problem at this time. The combined disadvantage of resistance and weight of landing gear, however, as well as the realization that this unit is absolutely useless when an airplane is in the air, has tempted a number of engineers to seek some method of eliminating it on airplanes.

The necessity of keeping even small protuberances out of the air stream has led to a number of interesting detail refinements, such as flush wing fittings, retractable steps, and even in some cases retractable oil coolers and radiators. Retractable radiators, however, heve not come into use to any extent in this country because of the fact that tha large majority of commercial airplanes are powered with air-cooled engines.

A need for more study of the problem of aerodynamic interference is apparent from a recent experience of the Ford Company. By cowling the outboard engines, changing their position with respect to the wings, and adding wheel fairings, an increase in high speed in the neighborhood of 20 m.p.h. was obtained.

Although military in nature, a development of particular interest is the new Fokker twin-engined observation plane. This machine has a retractable landing gear and its Curtiss Conqueror engines are mounted almost entirely in the thick wings, with only a small portion of their housing protruding beyond the surfaces. The propeller disc is fairly close to the leading edge on the inboard side, but a considerable distance from it on the outboard side, due to the taper of the wing.

Aerodynamic Novelties

TURNING to the group of less conventional airplanes, a number of interesting developments can be considered as having first been introduced in 1930. In this connection, it seems justifiable to mention several of the Guggenheim Safe Aircraft Competition entries. Although these airplanes might properly be considered as belonging to the year 1929, development of several of them has been continued during the past year. The contest offered an excellent opportunity for the engineer to study the various types of variable lift devices in common use. Area, camber and even incidence were made variable in flight in the contesting airplanes by various devices, and the results of the contest seem to indicate that probably the leading edge slot and trailing edge flap afford the best combination for a wide speed range. One cannot fail to observe, however, that none of these features heve as yet been applied to any great extent to American commercial airplanes. This also applies in a degree to the floating aileron which operated so desirably on the winning airplane in the Guggenheim competition. During the past year, however, certain attempts have been made by the Curtiss Company to apply floating ailerons of the Tanager to existing designs.

Experiments are also being continued by the Cunningham-Hall Aircraft Company on its entry in the Guggenheim contest. This machine will be remembered as having embodied the Hall "combination airfoil," an ingenious variable lift device which has been described in some deatil in past issues of AVIATION. Following tha general lines of the Guggenheim contestants, an interesting airplane developed by Waldo Waterman was introduced at the Chicago National Air Races. This machine embodied a device for changing the dihedral and incidence of the wing in an attempt to obtain more desirable stability characteristics. This machine is reported to have been undergoing tests by the N.A.C.A.

Gradual development of the Autogiro has been under way during the year by the Pitcairn-Cierva Company and a number of detailed improvements have been effected. These include mainly a mechanical engine-driven starter for the rotating vane system and a landing gear developed to meet the demands for long shock absorber

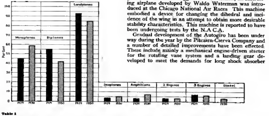


Table 1
Numerical study of approvals for 1930 with comparative total charts for 1929 and 1930

		Monoplanes		Biplanes		Open		Closed		Landplanes		Seaplanes		Land and Sea		Amphibion		2-Engine		3-Engine		Diesel	
	No. A.T.C.	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
1st quarter	20	12	60	8	40	10	50	10	50	15	75	2	10	2	10	1	5	0	0	2	10	0	0
2nd quarter	30	20	67	10	32	14	47	16	53	29	97	1	3	0	0	0	0	0	0	2	7	3	10
3rd quarter	37	20	54	17	46	20	54	17	46	30	81	2	5	0	0	5	14	3	8	2	5	0	0
4th quarter to Dec. 1st	11	6	55	5	45	7	64	4	36	10	91	0	0	0	0	1	9	0	0	0	0	0	0
Total	98	58	59	40	41	51	52	47	48	84	85	5	5	2	2	7	7	3	3	6	6	3	3

travel in vertical landing. Slots and flaps also have been combined in the McDonnell "Doodle Bug," another of the Guggenheim entries whose sponsors heve seen fit to continue its development

Advances have been made by the school of designers advocating lift producing fuselage, as exemplified by Bellanca and Burnelli. The Bellanca "Air Bus" which has a wing form similar in many respects to its predecessors, the Tandem, and the Roma, provides a goodly passenger capacity with a single Curtiss Conqueror Engine. A new Burnelli creation, aerodynamically similar to its predecessors but structurally improved, was also introduced during the year

Helicopter development has been active during the past year in this country and Europe. The most successful venture of this kind to date is the flight of such a machine designed by Corridino D'Ascanio at an airport near Rome, Italy. In this country, the Curtiss interests have been sponsoring the development of a helicopter designed by Maitland Bleecker and this machine should soon be ready for test flighta

Even more recent than the Italian helicopter flighta are those of a Spanish machine designed by Raoul Pescara, at Barcelona. The European machines both differ fundamentally from the American in that they have two rotating wing systems turning in opposite directions. The rotors of the Italian machine are two bladed while those of the Spanish craft might be considered as eight bladed, having four pairs of blades for each rotor.

Structural Developments

PROBABLY the outstanding feature in structural design has been the continuous trend toward the use of metal. The demand for aerodynamic cleanness has resulted in a number of interesting cantilever wing designs. Some interesting developments in monocoque fuselage construction have been brought to light and several ingenious wing structures have been devised

Among planes embodying novel types of metal construction are included the Northrop, Towle, Theden, Solar, and Prudden-Whitehead. The Thaden and Towle are described elsewhere in this issue In most of these wings the conventional spar and rib system is replaced by various other arrangements in which the metal skin carries a portion of the loads and which in most cases cannot be investigated by the usual methods of stress analysis. It has, therefore, been necessary to resort to static testing and much time and money has been expended in determining the characteristics of these structures

An experimental metal fuselage was constructed for a Lockheed airplane and exhibited at the Detroit Aircraft Show This structure compared favorably in weight with the wooden structures alresdy employed on these airplanes and possessed all of the aerodynamic advantages of the wooden body. Among the other interesting metal planes of the year is the Consolidated Fleetster which also has a somewhet unique structural arrangement

Almost all of the airplanes thus far discussed have employed riveted aluminum alloy in their structures In several quarters, however, research is progressing on the use of stainless steel, fabricated by electric spot welding At the present time this movement has not progressed beyond the wing rib, but at least one airplane using such ribs has been fully approved by the Department of Commerce. A complete remodelling of existing spot welding machinery has been necessary in most cases to produce desirable results and, this having been accomplished, the interested organizations are progressing with the development of other production machinery for this type of work

Landing Gear Designs

AS A result of the use of low-pressure tires, it has been possible in many of the lighter airplanes to eliminate the shock absorbing mechanism in the landing gear. This is also true of the tail wheels employed on some of the light and medium weight airplanes The effect of this movement on landing gear designs in general has been a tendency to return to the cross-axle type which was popular during the post-war period. In this type of gear, however, the axle is usually faired, in some cases to a true airfoil section and several designers have assumed this surface to be lift-producing in their calculations

Satisfactory brakes have been developed for the diminutive hubs employed in connection with low-pressure tires and many different types of brake controls

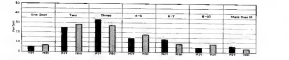


Table II Quarterly values for useful load-gross weight ratios and power loading

	No. A.T.C.	Single-Seat No.	Per Cent	2-Seat No.	Per Cent	3-Seat No.	Per Cent	4- and 5-Seat No.	Per Cent	6- and 7-Seat No.	Per Cent	8- and 10-Seat No.	Per Cent	Over 10-Seat No.	Per Cent	Average Hp.	Average Useful Load-Gross Weight Ratio	Average Power Loading
1st quarter	20	0	0	3	15	7	35	0	30	1	5	2	10	1	5	327	0.36	13.15
2nd quarter	30	4	13	9	30	5	17	0	30	3	17	0	0	1	3	337	0.39	13.36
3rd quarter	37	3	8	12	32	8	22	3	14	1	3	6	16	2	3	274	0.37	13.08
4th quarter to Dec. 18	11	0	0	3	27	0	55	1	9	1	9	0	0	0	0	205	0.37	13.60
Total	98	7	7	27	30	30	27	10	10	0	0	0	0	4	4	266	0.55	13.35

are in general use. Brakes and self-starters are rapidly becoming general standard equipment.

Light Plane Development

A REVIEW of the year would be seriously incomplete without some mention of the development of light airplanes in America and a number of inexpensive one- and two-seaters have been placed on the market during the last few months. Most of these airplanes are priced between $1,000 and $2,000 and are powered with engines below 50 hp. The group is exemplified by such products as the Aeronca, Heath, American Eaglet, Taylor Cub, Cessna, and a number of others. The demand for these airplanes has led a number of engine manufacturers to design light inexpensive engines, usually of two or three cylinders and, in order to obtain this type of power plant, engine designers are looking toward the two-stroke-cycle type Most of the airplanes in this class are structurally conventional and are monoplanes characterized by high aspect ratio and low wing-loading Their strong resemblance to gliders has given rise to the expression "power gliders" a term for which there seems to be no justification.

Research Progress

IMPORTANT research is progressing in the government laboratories and the various colleges throughout the country, and in recent months there has been a tendency on the part of some of the pioneers of the industry to abandon production for original research and to establish private laboratories to study fundamental problems. Such men as Grover Loening, Charles Lawrance, and Henry Berliner are now directing work of this type

A number of very important contributions have been made by the National Advisory Committee for Aeronautics, and the work of the Committee's laboratory at Langley Field is having a profound effect on airplane design One example of this, a study of the drag of the individual parts of an airplane, has already been cited. Much valuable information is being obtained by this organization by means of full scale and full flight measurements, and, a number of ingenious instruments have been developed for this work One of the most significant undertakings that the N.A.C.A. has initiated constitutes a detailed study of the problem of spinning The preliminary work reveals that there are some 800 factors affecting the spin and the research laboratory is making a systematic study of these factors Attention is also drawn to a very valuable propeller chart published in a recent report of the committee which should prove an invaluable aid to engineers in the problem of propeller selection

Approved Types

THERE is probably no better index of the progress of airplane design than a numerical study of the approved type certificates granted to airplanes of a particular period as compared with those of a previous period There has been a considerable decrease in the number of airplane designs approved for the first time during 1930 although a great many have been approved with slight modification. Inasmuch as the group is but one-half of the size of the 1929 group, it is probable thet the comparison of the yearly totals as shown in the accompanying chart will be most enlightening. The total charts are based on the total column in their appropriate tables, as compared with a similar figure for 1929

One of the outstanding tendencies, as indicated as a result of this study, is the continuous increase toward the monoplane. This tendency is not restricted to commercial design nor is it restricted to this country. It is obviously the result of structural developments which has made it possible to utilize the aerodynamic efficiency of the monoplane with ever decreasing sacrifice of structural efficiency. It is also the result of the increasing demand for closed airplanes and the fact that a number of excellent low wing designs have been developed

The percentage of open biplanes has fallen below that of closed monoplanes during 1930 although the figures for the last half of the year indicate a tendency in the opposite direction or a reversion to the open biplane supremacy. Closed biplanes have virtually disappeared from the new approvals for the year, their only representative being the Sikorsky S-38 in a limited form and it is obviously erroneous to consider this machine as representative of the biplane class for 1930 as it was primarily a much earlier development and is actually a sesquiplane.

More than double the 1929 proportion of amphibions is noted in 1930 but the seaplane has made only small gain. If, however, the possibility of interchangeable flotation gear for land planes is considered, the seaplane group should make a considerably better showing. It is probable that, in actual service, there are more seaplanes and amphibions than the present study indicates.

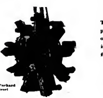
No appreciable tendency is noted as regards the number of engines employed in airplanes and the proportion of two- and three-engine planes is virtually the same as in the past year. 1930 has seen few, if any, approvals of planes with war surplus engines A new column has been added to Table I to provide for the Diesel-powered airplanes thet have been approved, and the peak of this group seems to have occurred in the second quarter of the year or approximately at the period of the introduction of the first commercial Diesel aircraft engine in America.

The larger proportion of Table II is devoted to a study of the year's designs as regards seating capacity and the accompanying total chart shows several significant facts The three-place plane has at last given way to the two-place type and the four- and five-place planes have gained at the expense of the six- and seven-place types. Insofar as existing or available power planta influence design, this indicates a tendency toward lower power loading which will be discussed later.

The column devoted to single seaters is beginning to bear out our belief as expressed in last year's study of this situation and a slight increase is shown. It is highly probable that this increase will become continuously greater when approved type certificates have been granted to the large number of existing light, single seater airplanes. The proportion of transports carrying more than ten passengers has gone downward instead of upward this year

As indicated elsewhare in this paper, the average value for the power loading of the group of airplanes has remained virtually constant during the four quarters of 1930 This value fell steadily during 1929 but since the last quarter of that year has been approximately 13, with a yearly average for 1930 of 13.35. While this is due in part to the disappearance of the conventional three-place OX-5 powered type of plane, it indicates that any average performance gain for the year has been accomplished without increasing power.

POWER PLANT PROGRESS



The Packard Diesel

The past year has been particularly rich in power plant design developments. A review of the achievements of this period and their interpretation by one of the leaders in the field, constitute the subject of this article.

By Prof. C. Fayette Taylor

Massachusetts Institute of Technology

THE year 1930 marks a number of rather important developments in aircraft power plants, not only in the field of practical application, but also in those fields of research and experimental development which give an indication as to the future trend of this most important branch of aeronautical engineering

Ring Cowlings

AMONG the developments of most immediate practical importance was the publication of a large number of data regarding various arrangements of "ring" cowling for air cooled engines. ["Comparative Performance Obtained with XF7C-1 Airplane Using Several Different Engine Cowlings," N.A.C.A. Technical Note No 334, Feb 1930; "The Resistance of Engines," by H C H Townend, *Aircraft Engineering*, April, 1930] Although this work is perhaps a matter chiefly of aerodynamic importance, the possibility of its profound effect on trends in engine design make it of vital interest to the power plant engineer While the N A C.A cowling, developed at Langley Field, was announced in 1929, the first results of a systematic investigation of the many variables which affect the performance of this type of cowling were not available until 1930 This work has been continued at Langley Field throughout the year in the form of a consistent program of research, where the different variables have been investigated in an orderly fashion under the practical conditions of full flight The results confirm the earlier data, which indicated that the parasite resistance of the air-cooled radial engine can be reduced to a point where it is quite comparable with that of the equivalent power plant of any other type, even including the Prestone-cooled Vee engine. To date the author has seen no carefully controlled tests which indicate a very great aerodynamic superiority of the Prestone-cooled engine, with radiator, over the equivalent air-cooled radial installation with the best form of ring cowling An accurate comparison of the two under carefully controlled conditions would certainly be of wide interest.

Another surprising feature of the ring cowling tests is the great reduction in drag to be obtained by comperatively narrow rings which interfere very little with the forward vision between the cylinders. All of this work indicates that the radial air-cooled engine is not nearly so bad, aerodynamically speaking, as one once supposed, and it looks as though this type would continue to hold its important place in the scheme of things aeronautical, as long as the internal combustion engine remains in its present general form.

While speaking of the aerodynamics of aircraft engines, one should not omit to mention the elaborate program of investigation now under way in the Langley Field 20-ft. tunnel on the problem of the location of an engine nacelle and propeller with respect to the wing, in an outboard installation ["The N.A C.A Meets the Industry," by L. E Neville, AVIATION, May 24, 1930] The possible effect of the results of this research on engine design should be of vital interest to all those interested in airplane power plant development

Diesel Power Plants

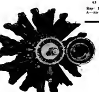
IN the field of endeavor confined to the details of the engine itself, the outstanding trend in research in 1930 has been toward the high-speed fuel injection cycle There is hardly an internal combustion engine laboratory in the country that is not devoting some attention to the possibilities of this type.

Easily the outstanding development in this field in 1930, was the long awaited publication ["The Packard Diesel Engine," L. M. Wonlson, *S A E Journal*, April, 1930, p 431; "The Packard Diesel Aircraft Engine," Edward P Warner, AVIATION, April 5, 1930, p. 684; Discussion of L M Woolson's peper, *S.A.E Journal*, Sept 1930, p 279.] of the details of construction of the Packard Diesel engine and the placing of this engine on the open market as a power plant for airersft. The details of construction are now so well known that a repetition of them here would be entirely superfluous, but one cannot refrain from calling attention to the number of especially clever design features, such as the cylinder hold-down system and the flexible

mounting of the propeller hub and counterweights, which take care of the very high pressure and torque peaks without the addition of excessive weight or undesirably high stresses One is inclined to question whether the disagreeable escaping of exhaust gas from the intake ports can be overcome, while still retaining the obvious advantages in weight and simplicity of the single valve. An especially commendable feature of the engine is the use of individual fuel pumps, each integral with its injection nozzle,—a system which provides a virtually independent injection system for each cylinder and avoids the use of tubing and connections under extremely high pressures The untimely death of the designer, Capt L M Wonlson, cannot be omitted from a review of the major events of 1930 in the field of aircraft power plants By it, the industry was deprived of its most original designer on this side of the Atlantic.

Of less immediate interest to American aviation, but of perhaps equal importance in the basic development of oil burning power plants was the publication of the first complete and authentic descriptions of the new Junkers Diesel engine which was first flown in the winter of 1929 ["Development of the Junkers Diesel," Dr. Gasterstadt, *Automobiltechnische Zeitschrift*, Jan 10 and 20, 1930. Translated in N A C A. Technical Memorandum No 565, May, 1930] The general characteristics of this engine have been known for some time, but the year 1930 marked the first broadcasting of its detailed mechanical arrangement

Several quite remarkable features of this engine may be worth commenting upon here. The double piston arrangement is, of course, entirely without precedent in aviation engines, but is the arrangement which has been used for some time on all of Dr Junkers' stationary Diesel engines The fact that the engine operates on the two-stroke cycle is especially noteworthy since the use of this cycle for some years has been confined to very small engines only, while the Junkers engine is rated at 650 hp at 1600 r p m., giving a brake mean effective pressure of 92 lb per sq in, equivalent to 184 lb. on the four stroke cycle This is a noteworthy performance for an engine with no more piston displacement than one of our standard large size radials, although its weight is considersbly greater, being 1800 lb without water cooling system The use of a centrifugal blower for scavenging is unusual and accomplishes a considerable reduction in weight and size as compared with the positive blower generally employed for two-cycle engines In spite of its design, which appears awkward from the usual American point of view, this engine should be watched with considerable interest and may point to a trend toward the use of the two-stroke cycle in aeronautical Diesel power plants.



Internal piston and ring type reduction gear on a P & W engine

Approved Engine Types for 1930

A. T. C. Number	Designation	Type	Hp.	R.p.m
37	Michigan Aero, Rover	4LAI	75	1,975
58	Lambert, R-266	5RA	90	2,375
39	P. & W., Wasp Junior	9RA	900	2,900
40	Wright, Gipsy L-320	4LAI	90	1,950
41	Aeromarine, RAD-8	9RA	115	1,925
42	Lycoming, Lycoming R-680	9RA	215	2,000
43	Packard, Diesel DR-980	9RA	225	1,950
44	Am. Cirrus, Mark III Supercharged.	4LA	110	2,190
43	Western, L-7	7RA	150	1,850
46	LeBlond, LeBlond 85 (5DF)	5RA	85	2,123
47	Comet, I-E	9RA	163	1,900
48	LeBlond, LeBlond 70 (5DE)	5RA	70	1,950
49	MacClatchie, Panther X-2	7RA	150	1,900
50	Monaco, Pirate A-4	4LAI	90	1,923
51	Kinner, B-5, (R-440)	5RA	125	1,933
52	LeBlond LeBlond 110 (7DF)	7RA	110	2,150
53	Szekely SR-3	3RA	50	1,750
54	Warner Scarab Jr	5RA	90	2,033
53	P & W Wasp R-1340-C (Geared)	9RA	425	2,050
56	Chevrolet, Chevrolair D-6	6LAI	165	2,113
57	Fairchild, 6-390	6LI	120	2,150
58	P. & W., Wasp SC (10 1 Imp. gears)	9RA	450	2,190
59	Chevrolet, 333	4LAI	120	2,190
50	Am. Cirrus, Cirrus Hi-Drive	4LAI	93	2,100
61	Wright, Cyclone R 1820-E	9RA	575	1,900
62	Kinner (R-715) C-5	5RA	210	1,900
63	Milwaukee, Tank 502 (V-470)	6VA	113	1,650

Key: R—Radial, V—Vee, L—In line, G—Geared, I—Inverted, A—Air cooled, W—Water cooled. Numeral refers to number of cylinders

The research work on high speed Diesel engines, begun some years ago by the N A C A at Langley Field, has been continued during 1930 with some especially interesting performance results on a cylinder having a multiple orifice spray nozzle, designed to direct the fuel to all parts of the combustion chamber. ["Performance of a High Speed Compression Ignition Engine using Multiple Orifice Fuel Injection Nozzles," N A C A. Technical Note, No 344] Interesting results were also obtained from a cylinder of the pre-combustion chamber type, but those have not yet been published Unfortunately the publication of results on numerous private developments has been exceedingly meagre

The work of the N A C A and Pennsylvania State on the mechanics of fuel sprays for Diesel and other "solid injection" engines has continued during 1930, and has added much valuable data in this very important field [N A C.A Technical Notes Nos 332, 338 and 352 on fuel sprays, "Factors in Nozzle Design," by P. H Sweitzer, *A S.M E Oil & Gas Power*, 1930] One ventures to hope that the correlation of the numerous data on sprays with the performance of such sprays in typical cylinders will be undertaken by some competent laboratory in the near future

Fuel Injection With Electric Ignition

THE past year seems to have been also marked by a sudden interest in the possibility of fuel injection into the cylinder or manifold in connection with electric ignition This was no doubt stimulated by the full flight demonstration of a Pratt & Whitney Wasp operating with injection into the cylinders, apparently with entirely satisfactory results It appears thet such a cycle may

make possible the use of the lighter "fuel oils" without resorting to the solid injection Diesel cycle with its attendant high cylinder pressures There has been much activity along these lines in several important laboratories besides that of the Pratt & Whitney Aircraft Company, but unfortunately no published results have yet become available While details of the Pratt & Whitney engine have not yet been made public, it is known to be a standard Wasp engine in which the carburetor has been replaced by individual fuel pumps for each cylinder, injecting directly into the combustion chamber The pumps work on the so called "hammer" principle, probably being actuated by a "load and fire" mechanism where a spring, previously compressed, is suddenly released This engine has been demonstrated in flight and apparently runs as well on domestic furnace oil as on gasoline How much "doping" of the oil is necessary to prevent detonation with the standaed Wasp compression ratio has not yet been revealed

Supercharging

The question of supercharging both for altitude performance and for increasing sea level power output seems to have received an unusual amount of attention in 1930. Not only were some very important contributions made by the N A C.A and Bureau of Standards laboratories, ["Comparative Flight Performance with an N A C A Roots Supercharger and a Turbocentrifugal Supercharger," N A.C A Technical Report 355] but in April, Mr Ricardo startled the internal combustion engine profession by the announcement, in an article in *Aircraft Engineering*, of brake mean effective pressures of previously undreamed magnitude, obtained by supercharging a sleeve-valve cylinder in his laboratories at Shoreham-by-the-Sea One feels that this is bound to revive interest in the sleeve-valve engine, for some time considered defunct, in this country at least, for aircraft purposes The Bureau of Standards altitude chamber has also been busy on the problem of supercharging, but unfortunately the work has been almost entirely for the Army or Navy, and results are therefore not available for general distribution

Fuels

One cannot undertake a review of internal combustion engine progress in 1930 without mentioning at some length the research on fuels for carburetor engines which has been going on at the Bureau of Standards, under the auspices of the S A E, and at the laboratories of the U. S Air Service at Wright Field The former, largely in the field of the accelerating and vapor locking tendencies of fuel, has been covered by reports in the *S.A E. Journal* [Results of fuel research reported in the *S.A.E. Journal* in 1930 "Automobile Engine Acceleration," C S Bruce, Sept, 1930, p. 275; "Effect of Weathering on the Vapor-Locking Tendency of Gasolines," O C Bridgeman and Elizabeth W Aldrich, Sept, 1930, p. 344, "Vapor Locking Tendencies of Automotive Fuel Systems," W C Bauer, Sept, 1930, p 352; "The Effect of Airplane Fuel Line Design on Vapor Lock," O C Bridgeman and Hobart S White, Oct., 1930, p. 444; "The Vapor Locking Tendencies of Aviation Gasolines," O. C Bridgeman and H S White, Aug, 1930, p 218] while the results of the very interesting work on fuels as particularly applied to high performance aircraft engines, conducted by S D Heron at the Air Service laboratories, constitute a major contribution to this particular subject ["Fuels for High Performance Engines," S. D Heron, *A.S M E Quarterly*] This work has been especially concerned with the detonstion characteristics of aircraft fuels and particularly with regard to methods of measuring these characteristics under conditions similar to those in an aircraft engine The results of this investigation to date indicate that the relative anti-knock qualities of two fuels may vary considerably with the conditions of operation under which they are tested In spite of this, one continues to hope thet the long awaited standardization of anti-knock measurements on commercially available fuels is at least within sight.

Miscellaneous Research

The Bureau of Standards has been continuing on basic research in its own quiet way during 1930, and has contributed much to our fundamental knowledge of the physics of the internal combustion cycle. Professor Stevens reports progress in the mechanics of flame propagation at constant pressure ["Combustion at Constant Pressure," F. W. Stevens] and intensely interesting work on the ignition ability of electric sparks has also been carried on An investigation of flame propagation in a cylinder, as observed through a series of quarta windows by means of a stroboscope, has been going on at the Bureau for some time, and bids fair to be an important contribution

Developments in Orthodox Types

In the orthodox type of gasoline airplane engine improvement toward greater power and lower weight for a given piston displacement continues A definite step in this direction has been the development, by such concerns as Pratt & Whitney, of the internal type of propeller reduction gear which reduces compliestion enormously as compared with the planetary type, while still retaining the advantages of the latter in respect to compactness and light weight General use of propeller reduction gears in this country for commercial aviation still appears to lag behind European practice. [The Effect of Reduction Gearing on Propeller Body Interference," N.A.C.A Report No 338.]

Further experience during 1930 with Prestone-cooling seems to have led to the feeling that this type of cooling is worth while mainly for military and racing purposes. Experience with Prestone-cooled systems thus far seems to have indicated a considerable increase in the maintenance problem in general service

In a review of this kind one should not fail to mention the continued development of large water cooled engines in England and Continental Europe. Such power plants as the Rolls Royce model H, the Hispano-Suiza 600 hp model, and the 1000 hp Isotta Fraschini have created very little stir in this country, but are apparently giving noteworthy results in Europe The external appearance of these large European engines creates an impression of beautiful, though rather complex, workmanship, somewhat foreign to many American engines.

New American Engines

The number of concerns venturing to enter into the production of aeronautical engines in this country during 1930 was not quite so large as during the previous year but still represents a rather formidable list as indicated by the table of Department of Commerce type certificates issued during 1930 For a numerical study of this group tha reader is referred to page 327, December, 1930, issue of Aviation.

AIRSHIP DEVELOPMENT

By

Comdr. Garland Fulton (CC)

U S Navy Bureau of Aeronautics, Navy Department

Airship progress in the United States during 1930, while not immediately striking to the eye, has nevertheless been very real

Excellent progress has been made on the construction of the ZRS-4 (U S S Akron), the first of the Navy s new airships Erection of frames was started in November, 1929 The end of this year will see complete erection of all the framing, except possibly the extreme bow and stern portions and attachment of fin structures In June, a successful "proof test" to check theoretical calculations was conducted on a section of the airship near amidships, enclosing a gas cell of nearly 1,000,000 cu ft volume, inflated with helium Engines have been delivered and tests to date have been satisfactory on the novel transmission to give propeller thrust in four directions—ahead, astern, upwards, and downwards. It is confidently expected that this airship will be ready for trial flights about the middle of 1931.

Operations of the U S S Los Angeles by the Navy and of several smaller airships by Army, Navy, and private interests have continued The operation by the Goodyear Tire and Rubber Company of a fleet of several airships for training and advertising purposes has been notably successful The Gordon Bennett International Balloon Race held at Cleveland on Sept 1 was again won by an American entrant It is regrettable, and is

A portion of the structure of the dirigible Akron

perhaps an indication of declining interest on the part of other countries, that of the six entrants in the International Race only three were from outside the United States. In the National Race there were fourteen entries, eight of them privately owned

In order to thoroughly appraise the material condition of the U S S Los Angeles after six years of miscellaneous service, a careful inspection of her was conducted The Naval Board found her present condition to be good and saw no reason why she should not be continued in service for two to four years longer, provided she is operated in the same careful manner as in the past and provided worn or deteriorated parts are replaced as nec-

The Los Angeles rides to the mobile mast

essary from time to time The durability of the outer cover fabric has been very striking When the Los Angeles is no longer fit for service, it has been recommended she be destroyed through ground handling tests Such tests could be made to afford information of value

Important developments in rigid airship ground handling methods and equipment have been underway continuously for the past several years The past year has seen definite substitution of mechanical handling in lieu of man power for several phases of ground handling Further work is indicated before a final solution satisfactory for all phases of the problem will be reached

OPINION still remains divided on the merits and demerits of high versus low, or stub, masts for airship mooring Probably neither is of universal application, and the best type must be selected to fit a given set of conditions The mobile stub mast as a piece of handling equipment has been a definite success One existing Naval mast is mounted on crawler treads Another of similar type, but arranged to travel over rails, is under construction, together with necessary additions to trackage Many successful moorings have been made to the low type of mast at Lakehurst and with the gradual accumulation and perfection of mechanical equipment, the number of men required to effect a mooring is bring reduced. Even with the incomplete and admittedly imperfect equipment now available, the Los Angeles has been handled out of the shed; across the field, and secured in her riding position with the aid of sixty men

The metal-clad airship ZMC-2 has now been in service fifteen months She incorporates a number of novel features which are being watched with interest Gas tightness of the hull, while showing some decline, still compares favorably with a fabric hull airship As to durability of this type of structure, it is too early to draw conclusions

Technical progress along various lines accessory to the airship field has continued Development in the United States of a solid injection type engine suitable for airships is underway, but it is too early to predict the outcome of these efforts The everlasting search for more suitable gas cell material has produced a gelatin-latex fabric that has given very satisfactory results in actual service for a period of nine months. An airship envelope is being constructed with which to conduct full-scale tests using fuel gas as an airship fuel. One phase of this problem is how to handle the repurification of helium that has become polluted with a high-hydrogen-content fuel gas Better cements have been developed for making seams in rubberized fabric. A really satisfactory type of water-recovery apparatus thet will not add too much to the resistance of the airship is still much needed for helium-filled rigid airships.

With the opening of a new government plant near Amarillo, Texas, increased quantities of helium have become available Low-cost helium is basically a question of large production, and net production costs of less than one cent per cubic foot have been reported by the Bureau of Mines Several additional tank cars for transportation of helium have been put in service by the Navy Department

OUTSIDE the United States, the Graf Zeppelin has operated on more or less regularly scheduled flights and generally has carried full passenger lists Her triangular flight (Europe—South America—United States) in June was a striking achievement, second only to her record-breaking voyage around the world last year A new and larger shed has been completed at the Friedrichshafen works of the Zeppelin Company, and work has actually started on a new and larger airship to be known a LZ-128 It is understood that this airship expects to use helium This decision has been made subsequent to the R-101 disaster

The two British airships, R-100 and R-101, had their trial flights late in 1929 Each airship incorporated in its construction variations from usual Zeppelin practice The R-100 employed duralumin as the principal structural material The R-101 employed a stainless steel for certain portions of structural members, amounting to 25 per cent by weight of the total

The R-100 made a round trip voyage from England to Canada in July and August This marked the twelfth crossing of the Atlantic by airship—six westward and six eastward voyages The Pacific has been crossed once —west to east For nearly two weeks the R-100 remained based on the mast near Montreal which represents the last word in modern equipment for the high-mast type Damage to fabric fin covering was successfully repaired while the airship rode to the mast

This accidental damage to fin covering recalls similar damage to the Geaf Zeppelin in 1928, and focuses increased attention on possible weaknesses in airship fins It is noteworthy that in each case, the airship continued her voyage in safety High-speed airships clearly demand that fin coverings be adequately strong and be supported at more frequent intervals

IN each recent year the months September or October have produced some noteworthy airship event, and 1930 is no exception The unfortunate disaster to the R-101 was a fearful shock As this is written there are at hand only press reports as to circumstances which might have caused this tragedy, but nothing has been seen which throws suspicion on the structural integrity of the airship. One cannot read the current newspaper accounts without having a number of questions arise—Why was there only a brief trial flight after the major operation of adding a new bay to the airship? What were the actual weather conditions? Were they known in advance and was effort made to dodge the worst weather? Was the airship abnormally how-heavy, and if so, what caused this condition? Was the airship's precarious situation realized and were all reasonable measures taken to maintain control of the airship? It is greatly to be hoped that the investigation now in progress will bring forth enlightening facts on the technical aspects of this tragedy, so that future generations of airships may profit Undoubtedly, the large loss of life was a secondary phase of the accident and resulted from hydrogen fire There is nothing which has so far appeared in reference to this disaster which negatives the opinion that helium filled airships, carefully designed and skillfully operated, are a safe means of transportation.

It is difficult to believe that the R-101 disaster will cause any permanent retardation in airship work, certainly not in this country where helium is comparatively easy to obtain. Public opinion, as evidenced through editorial comment, is still decidedly favorable to airship development. Further evidence of firm belief in airships is to be found in the plans of at least one or two groups, and notably of the Goodyear-Zeppelin interests,, in alliance with the German Zeppelin company and with American financial interests, for the establishment of trans-oceanic lines carrying mail, passengers and express

AIRPORT CONSTRUCTION IN 1930

What was the 1930 record in this activity and how does it compare with that for 1929? In this article the important elements are described and the results summarized. The conclusions present a highly satisfactory condition in this department of the industry.

ONCE more it is time to look back over a calendar year and consider the record made in the all-important matter of providing terminal facilities for this country's aircraft. Most conspicuous, of course, is the fact that construction dropped below the record for 1929 and far below the prophesy for 1930 Again, however, as last year, airport construction was about as prosperous an activity as could be found in the aviation industry. It shared in the prevailing recession, but to a much smaller degree than most of the other departments.

A year ago we reported that in 1929 between $45,000,000 and $50,000,000 had been spent on airport construction projects With conditions then obtaining it appeared that an even larger amount would be thus invested during the year just closed We estimated, quite conservatively we then thought, that 1930 would see between $50,000,000 and $75,000,000 spent on the various phases of port building and refinement Like most other estimates for 1930, this one proved high. The actual outlay was close to the $35,000,000 mark.

This last figure was secured by the same method as that published for the previous year [See AVIATION, Feb 15, 1930]—by tabulating all available reports on *completed* airport construction work. It obviously and of necessity is indicative only, since it is quite out of the question to secure a complete and accurate summation of all the work done. We may consider it at least a minimum, however, for undoubtedly there were projects which escaped reporting, and there were instances also of extensive work reported where the data were too vague to merit inclusion in our statistics. There are eight salient characteristics of the 1930 record:

Randolph Field building area and airport construction progress

1. A great deal of the construction was confined to the completion of projects started in 1929, and fewer brand new projects were launched.

2. As in the preceding year, there were far more municipal projects in 1930 than private or commercial. Approximately 70 per cent of them were under municipal or government auspices in 1930, while in 1929 about 57 per cent (175 as compared with 130) were municipal. This indicates that civic communities could best afford to carry on with airport construction programs, that municipal projects continue to dominate in the general development of a national airport map, and that even this department of aviation depends to a large degree on governmental interest.

3. Construction in 1930 followed the tendency to build for permanence, with even more appreciation of the importance of provisions for comfort and of the aesthetic aspects than had been displayed in the preceding year. To the air-travelling public the airport is a terminal comparable to those of railroads and steamships. Used to comfort, convenience and pleasing architectural surroundings they look for similar attributes in the aeronautical set-up. Though they have been disappointed in the past, they are gradually being provided with something at least approximating their demand.

4. There was a very definite slowing up during last year in the initiating of projects by commercial interests as an investment. The fact that an airport must usually be considered a sort of public utility or a very long term investment discouraged the promoters, leaving the field to large transport or general operating companies and to municipal and semi-municipal groups (that is, such projects as those sponsored by a chamber of commerce on behalf of the cities).

5. Many airports have realized in the past twelve months that in their enthusiasm to keep abreast of events in aviation they had provided more building space than would be needed for some time. In general it may be said that we have too many buildings and not enough land. This statement should be interpreted only in its widest sense, however, for the exact opposite obtains at many individual points.

6. Another realization which has been causing concern is that in many cases elaborate airport equipment, runway installations, etc., are being found unnecessary as yet. This is allied to Item 5 but deserves separate emphasis. Many communities have not only over-built but have needlessly equipped themselves with installations they could ill afford. All that many communities

Table 1: Approximate Minimum Outlay

	1930 (to Nov. 1)	1929
East	$7,574,000	$12,834,000
South	5,967,000	4,554,000
Central	8,033,000	9,751,950
North Central	2,423,000	1,191,800
West	2,702,000	8,469,765
Total	$26,699,500	40,981,815

require for some time to come is a landing field with service for the occasional visit of aircraft rather than elaborate facilities capable of handling a transport service.

7. Grading, drainage and runway improvements came in for more attention than ever before. Hard surfaced runways were installed at scores of major ports, many of them fields which had been in existence for some time and which were adopting the new surfacing to meet the requirements of modern transport operation in all weathers. There was a growing appreciation of the need for adequate drainage. Everywhere earnest attempts were being made to eliminate, in one way or another, the mud, or wet, treacherous ground which has characterized so many ports.

Table 2: Approximate 1930 Outlay by Areas

	South	North Central	Central	West	East
No. of new hangars	50–65	10–15	22–25	34–38	25–50
Hangar appropriations	$2,000,000	$900,000	$1,250,000	$2,000,000	$2,500,000
No. of adm. bldgs.	8–10	5–7	8–10	7–9	5–7
Adm. bldg. appropriations	500,000	250,000	1,000,000	250,000	800,000
Runways	40,000	125,000	200,000	*	100,000
Lights	250,000	75,000	50,000	50,000	100,000
Grading and drainage	1,250,000	250,000	800,000	750,000	800,000
General development	3,000,000	2,250,000	7,000,000	1,250,000	2,000,000

*Not available.

8. The construction in the first half of 1930 was but slightly under 50 per cent of the total for 1929. It appeared in those months that this year's construction would just about hold its own as compared with a year ago. However, the slowing down which started in the first six months became more marked in the second period as projects reached completion and new construction started fell off. This was in general a normal, seasonal trend.

Table 3

	Number of Individual Projects	Number General Development Projects	Number of Hangars Built	Number of Administration Buildings Built	Sites Acquired but Improvements not Reported
East	50–60	23	18–50	6–8	12
South	65	50	15–50	10–12	16
Central	90	50	30–55	10–12	15
North Central	25–30	3–5	8–18	*	8
West	85–95	20–25	30	12–15	15

*Not available.

About 150 new hangars were built in the United States during last year, representing an investment of approximately $8,000,000. About 35 or 40 administration buildings were erected at a cost of approximately $2,500,000. More than 20,000 acres of land were acquired for airport use at a total cost of about $5,000,000. There were about 40 projects involving runway extension or improvement and these cost close to $2,000,000. Between 30-35 individual lighting installations cost more than $500,000. Fifty or so grading and drainage projects involved an outlay of more than $3,000,000, while general development cost close to $16,000,000. There were miscellaneous projects to account for at least another million or two.

For 1929 we reported 85 new development projects—which we treated as a whole, without reference to the individual items of grading, lighting, etc.—and these involved more than $25,000,000. Besides these there were, of course, many individual cases of surfacing, lighting, building construction, general improvement, and miscellaneous work. The geographical areas used herein are made of the following states:

East: Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, and the District of Columbia.

Central: Ohio, Illinois, Indiana, Nebraska, Missouri, Kansas and Iowa.

North Central: Canada, North Dakota, South Dakota, Michigan, Wisconsin and Minnesota.

South: Tennessee, Florida, Louisiana, Texas, Mississippi, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Kentucky and Arkansas.

West: Washington, Oregon, California, New Mexico, Arizona, Idaho, Montana, Utah, Wyoming, Colorado, Nevada and Oklahoma.

Construction in two sections of the country actually increased in 1930 over 1929. The South was particularly active. Though its total investment may have been less than in some other areas, in number of individual projects it surpassed the rest. The other section to show a gain was the North Central area, including a part of Canada.

Using the figures actually reported to us, and without including corrections applied to the totals for the years, we have in Table 1 the interesting comparisons of work in the various sections.

A more detailed barometer of what happened in 1930 is shown in Table 2, which includes estimates by geographical section based on such data as the above. This shows clearly the high pace set in the South in port construction matters last year. More than 50 hangars were built in that area, approximately a dozen individual administration buildings were erected and more than 10,000 acres of land were secured for airport purposes.

For various reasons the sectional data for 1929 and 1930 could not be compiled along exactly the same lines, so no direct comparison of two detailed tables is available. Some idea of the relation between the two years may be derived from the approximate figures for 1929 in Table 3.

Table 4: Department of Commerce Airport Figures

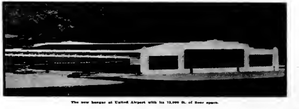
	Jan., 1930	Nov., 1930
All airports and fields, including government	1,561	1,813
Municipal	458	551
Commercial	491	800
Department of Commerce intermediate	282	326
Army	68	63
Navy	14	12
Marked auxiliary	246	290
Miscellaneous government activities	2	2
Proposed	1,391	800

The Aeronautics Branch issued about 500 new and revised Airport Bulletins during the year. Approximately 375 of these represented airports and fields not covered by bulletins before. The majority of the latter, of course, were brand new installations. The Branch reported at the first of the year and near the close the airport figures in Table 4.

What of the year 1931? What may we expect the total investment in construction to read and what may its outstanding features be?

It seems reasonable to expect that there will be between $20,000,000 and $30,000,000 worth of construction carried out this year unless there is a prolongation of the ebb-tide in general business affairs. This is based on the known projects planned for the coming months and on the rate of decrease experienced in 1930 over 1929. A small falling off may be considered normal, as the feverish airport building program could not continue indefinitely, and the obvious spots on the airport map have been well filled in. It should be emphasized, however, that airport saturation point is in sight.

Refinement of existing plants probably will be one of the most active of construction items this year. By the close of the year much equipment already installed should have been improved and better tuned to the service for which it was designed. Further attention will be given to the provision of comfortable passenger handling facilities, lighting, surfacing and drainage



The new hangar at United Airport with its 72,000 ft. of floor space.

DEVELOPMENT OF MILITARY AIRPLANES

By Major Clinton W. Howard

Chief Engineer, Materiel Division, Wright Field, Dayton, Ohio

An observation plane that tucks its wheels up into its wing

IN LAST year's experimental procurement program of the Air Corps the foremost emphasis has been placed upon increased speed for all military types of airplanes The corollaries of this major trend are, in order of importance—increased power—clean design and decreased weight—multiplicity of types

The principal advances in airplane performance are the result of engines of greater power and efficiency The present policy of the Materiel Division, therefore, in order to meet the constant demand for improved performance by the tactical organizations, is to devote its major efforts to the development of power plants

Increased speed can best be obtained by increase in power for a given piston displacement, and the trend of experiment for both liquid and air-cooled engines has been in that direction The power of the present standard air-cooled and liquid-cooled engines has increased from 10 to 20 per cent during the past year, as a result of fundamental studies involving compression ratio, supercharging, revolutions per minute, and increased brake mean effective pressure. The limits of these improvements are not in sight There are at present outstanding definite requirements and specifications for an engine of 1,000 hp, having the same displacement as the existing 600 hp types

Increased power as represented by the engines developed along these lines can only be obtained by the use of fuel which is an improvement over the present domestic aviation gasolines The United States possesses ample resources of high-grade crude oils suitable for the production of gasoline with exceptionally high anti-knock ratings. The petroleum industry, in co-operation with the Air Corps, has produced and made available to the American aviation industry a fuel conforming to the extremely rigid requirements of the new Army aviation gasoline specification The trend is toward a continuation of researches in fuel development, which it is believed offers possibilities for much further improvement in engine performance

The advanced models of airplanes of strictly military types utilize liquid-cooled engines with their decreased resistance, improved susceptibility to efficient cowling, and Ethylene-Glycol as a coolant From a structural standpoint these airplanes show a definite trend toward all-metal construction. The metal monocoque fuselage has distinct advantages over the now standard type of structure for the Army (fabric-covered steel fuselages with composite fabric-covered wings). There is a saving in weight and a decided improvement in streamlining and consequent reduction in drag

New models include both biplanes and monoplanes; however, there is a strong trend toward the monoplane. The "gull wing," as shown in one of the illustrations, has been found to have some advantages from the standpoint of vision, and the disadvantages from an aerodynamic standpoint are in some instances less than anticipated. In other instances these disadvantages are sufficient to make questionable the usefulness of this type of wing structure Some years ago it became apparent that along with the increase in power of engines other means should be sought to improve the performance of military airplanes. The internally braced all-metal monoplane wing offered the logical means of reducing parasite resistance. A vast amount of work has been devoted to the structural and aerodynamic aspects of this problem by the Materiel Division and by the manufacturers of commercial and military aircraft, with the result that the objections to the monoplane for military airplanes that are dived to their terminal velocities have been overcome Wing "flutter" has been eliminated and the desired strength obtained by the use of suitable materials and methods of construction. An internally braced metal-shell type wing of duralumin construction throughout has been recently tested It has a span of 55 ft. and with a unit weight of 1 83 lb per sq ft, it carried without failure a maximum load of 120 lb per sq ft. Such a wing is suitable for an airplane of 5,000 lb. gross weight, designed for a load factor of ten under high incidence conditions. There are now being produced all-metal monoplanes (monocoque fuselages) for attack, bombardment, pursuit, and observation airplanes.

Increase in speed at altitude has been obtained by supercharging, with the Turbo exhaust-driven supercharger appearing most promising However, all superchargers increase the weight of the engine and fuel load, with the result that the weight of a 600 hp engine installation, plus the fuel load, is more than 50 per cent of the gross load for present experimental single-seater pursuit models. This indicates that there will be, for engineering reasons, a trend toward a bi-place fighter for high altitude, as the increase in the structure necessary for an additional cockpit is very slight and practically the same performance has been obtained with the two-seater as with single-seaters with the same engine

Expressed in another manner, the difference in performance between a single and two-place airplane built around a 300 or 400 hp engine is much greater than the difference in performance between the most efficient single and two-place airplanes built around a 600 hp. engine With greater increments of power the advantage will be still more in favor of the two-place airplane and there will be a tendency toward the elimination of the single-seater fighter for use at high altitudes.

THE trend of all military airplane design is toward an increase in the number of types and models of a type As now established, there are eight major types of aircraft specified for the use of the U. S. Army Air Corps These are designated as attack, bombardment, observation, pursuit, transport, photographic, primary training, and basic training. The experience of the past year with both experimental and standard service type airplanes has shown that in practically all instances the performance of the existing planes is not sufficiently flexible to meet their function satisfactorily when a given model has been required to do the work of more than one classified type. The sacrifices in performance, especially speed, have been too great for the advantage gained from the maintenance and supply standpoint by reducing the number of types. Although there has been some increase in the scope of the tactical requirements to be met and in the variety of functions that the military airplane must perform, the increase of the number of distinct types as listed above has been due largely to engineering developments. It is also to be noted that the absence of a perfected and standardized variable pitch propeller has resulted in an abnormally great loss of horsepower and efficiency at altitudes less than the highest at which the rated horsepower of the engines can be developed That is, the airplane with a supercharged power plant has a great advantage in performance at high altitude over the airplane with the same engine not supercharged, but is decidedly inferior near the ground A variable pitch propeller will not completely solve this problem, however, and there is, and still will be, a necessity for two or more models of some military types in order to insure maximum performance under all conditions and at all altitudes

Illustrations of the tendency toward an increase in the number of types, and of the inability of the designers and builders of aircraft to construct a compromise airplane that will serve more than one requirement, are the photographic and attack types Although observation airplanes will continue to carry photographic equipment in war, there is a definite need for a special airplane which has little or no application to other military purposes except that it can readily be converted into a light transport. The characteristics of the present standard attack type airplane, which is a modified observation airplane, differ widely from the experimental models now under construction.

This article, although interesting in itself, would be even more interesting if coupled with one on the development of Naval Aircraft for the same period. A number of parallel and supplementary conclusions would be found. These are the best evidence that could be given of the increased harmony among military, naval, and commercial airplane design and operation, and of the extent to which each profits by drawing upon the knowledge and experiences of the others.

Fairing the landing gear and engine.

The new models are low-wing monoplanes with monocoque fuselages, racing type wings, and in some instances equipped with slots and flaps. They are powered with either direct-drive or geared Curtiss Conqueror engines using Ethylene-Glycol as a coolant The increase in speed is in the range of 50 m.p.h. over the present standard attack airplane, which is obtained by the sacrifice of characteristics essential for observation airplanes. In one of the illustrations an experimental model of a long-range observation type airplane provides for the seating of the crew of three in tandem The novel features of this airplane are the engine installation and the landing gear design The landing gear, electrically operated, folds back into the engine nacelles, the wheels completing the streamline section of the engine cowls The difference of speed with the wheels up and down amounts to approximately 15 m.p.h., which is well worth the additional weight on this particular type. This type of landing gear traces its ancestry to an Army racing plane which was brought forth in 1923

Commercial aviation has influenced the military models of the transport airplanes. In addition to the multi-engined standard type transports now used, there are being "service tested" a number of single-engined transports for specific purposes The small high-speed transports are being used for tenders for pursuit airplanes, carrying crews and minor parts, while the larger and slower single-engine types are being service tested as cargo airplanes for the purpose of transporting spare engines and more bulky equipment, as well as personnel, at a lower cost and with less maintenance than with the present standard multi-engined models. The policy is being still further extanded toward the utilization of the very largest types of commercial transport airplanes In times of emergency, airplanes capable of carrying bulky cargoes no doubt will have a very important function in supplying the advanced landing fields with technical and other supplies

Use of "gull wing" on a new two seater pursuit ship

At present there is one standard primary training type airplane. In 1929 a survey was made of commercial training airplanes in view of increasing the source of supply. It was found thet only one out of fifteen airplanes investigated would meet the military requirements in respect to design factors, accessibility, egress, and vision, owing to the fact that the majority of them were primarily designed for sport and passenger airplanes and then adapted to training purposes This year there are five commercial types that meet the military requirements for trainers, which may be taken as an indication of the tendency of manufacturers to observe the Army standards in the construction. The function of the basic training airplane is to provide a normal step for the student qualifying on the primary training airplane to the service airplane. In general, the controllability, stability, and belance of the basic training airplane approximate the characteristics found in the single-engine service type, however, the power unit and gross loading are smaller The trend of development is to retain the peesent welded steel fuselage construction and to step the primary training airplane up in performance and power, rather than to use a standard service type airplane with a smaller engine. It may be seen thet this policy is advantageous to both the goveenment and the manufacturers of commercial aircraft, and especially to those who conform to the load factors and other requirements of the Air Corps

The influence of the refinement of non-military airplanes is reflected in improvements on existing standard pursuit, observation, and bombardment airplanes The ring cowl is used with all air-cooled installations. Tail wheels (full swivel) form part of all standard equipment, and enclosed cockpits and streamlined wheels are in evidence in some of the experimental types On a given type, the addition of the ring cowl increased the maximum speed near the ground approximately 18 m.p.h., and streamlining for the wheels made a difference of 5 m.p.h. in the high speed

The equipment and armament of the strictly tactical airplane are being reduced in some instances for the purpose of lightening the load and decreasing fuselage dimensions The use of brakes, first developed by the Army and used on high speed airplanes, has been extended even to training types Navigation instruments are of primary importance on all installations, but there is a decided effort on the part of the Air Corps to eliminate engine as well as non-essential flight instruments, and other miscellaneous equipment which has been gradually accumulating in military aircraft

In conclusion, it is desired to point out that the trend is predominantly toward higher speeds for all strictly military types, and the utilization of all-metal and composite wing structures with metal monocoque fuselages For this reason, the liquid-cooled engine best fits the needs of the Army Air Corps, and its adoption with Ethylene-Glycol as a conlant has resulted in an outstanding saving in the power-weight ratio, with a prospect of further improvement with the use of newer coolants now under consideration The air-cooled engine, with its refinements of installation, will continue for some time to be the standard training and transport engine, with the possibility of a limited tactical use on certain other models of airplanes designed for operation at intermediate altitudes

GLIDING ACTIVITIES

A year ago we were on the brink of a great experiment, and its name was gliding. Came disillusionment, which threw the glider into widespread disrepute and seriously threatened its future prospects. By the close of the year, however, motorless flying was looking up. Elmira and a dose of common sense did it. Here is the record.

Gliding and soaring prospects in this country were never better than after twelve months in which we have ranged from an unsound and unreasoning enthusiasm at the beginning, down through a period of doubt, in many quarters verging on despair, and then on to a new confidence based on sober planning We have gone through the tribulations associated with a first burst of American enthusiasm, and we are squared around on a more mature basis

As a result of our 1930 experiences we learned:

That gliding and soaring may be expected to prosper in direct relation to the quality of our training and experience. That adequate background is essential, and is just what we have been lacking

That the logical aim of gliding is soaring, and thet the latter not only is now possible in this country but may perfectly well attain a caliber equaling the German performances.

That there is nothing inherently wrong with gliding or soaring, but thet we have been guilty of haste, carelessness and vain over-optimism

That the primary type has serious defects and that the secondary now appears the kind best suited to all average operations in this country This applies particularly to auto-towing, which we have developed to supply artificial hills where natural elevations are not available, or where operation from an airport surface is preferred

That both gliding and soaring are worth while for their own sake as a sport and science, and should not be regarded primarily in a commercial light, as part of a flight instruction course or as a panacea for the ailments of a manufacturing industry

That airplane towing is extremely hazardous and to be undertaken only by the most experienced, but thet auto-towing is perfectly legitimate if done with the proper equipment and in a proper fashion.

A year ago interest was nearing its zenith. A number of airplane manufacturers bed seen in the glider movement an opportunity to maintain factory activity despite the decline in plane building. Flying schools saw in it a novel and perhaps necessary adjunct to their instruction methods Airport operators perceived another attraction to draw the public to their fields Promotors saw an opportunity to make money The emphasis was on the commercial aspects, the sporting and scientific aspects were nearly forgotten

To supply an eager market, airplane manufacturers added primary gliders to their products and quickly dominated the field, since the smaller firms concentrating on gliders lacked comparable sales and manufacturing facilities Up to the middle of June four airplane manufacturers alone had produced more than 275 gliders—all of the primary type.

A Ford glider boat used in marine towing.

During the first half of the year we were still thinking of gliders as open, bicycle-seat vehicles launched by shock cord or auto-tow for short aerial "slides" of a few seconds' duration. They were alleged to be simple to build, light to transport, easy to assemble and repair, inexpensive, and practically fool-proof. It was

natural that this primary type should be the favorite of professional manufacturers, the amateur builder, and the enthusiastic buyer.

About the middle of Spring we began to realize that under existing conditions, and with the type of machine then prevailing, gliders could be transformed easily from the safe devices we had been told they were, into veritable man-killers. The generous support accorded by industry and public was being withdrawn. By late summer many of the gliders were collecting dust in storage or had been discarded entirely after major and minor crashes. The turning point in the fortunes of gliding, as well as the dawn of competitive soaring in this country, came with the First National Soaring Meet at Elmira, N. Y., Sept. 21 to Oct. 5, which served to focus attention on the efficient secondary or utility type and the significance of soaring. American soaring in 1930 had previously been confined to the vicinity of San Diego, where Hawley Bowlus and Jack Barstow had been active. The latter established an unofficial duration record of 15 hours.

At this Elmira meet, staged by the National Glider Association as part of its effort to co-ordinate and supervise gliding activities, some of the outstanding performances were:

Wolf Hirth of Germany attained an altitude of 2,928 ft. above his starting point using a German soarer, and won the first of the altitude prizes presented by AVIATION. Warren Eaton, using an American secondary, reached 2,409 ft. Hirth flew 33 miles across country. Albert Hastings, also using a secondary, made a duration flight of 7 hr. 43 min. 11 sec., and first and

Glider developed by the Waco Aircraft Corporation.

second prizes in landing to the mark were won by landings 3 and 5 inches from the stake. In the 99 qualified flighta of the meet the machines totaled 118 hours in the air.

Lack of proper supervision and regulation was another of the chief causes of the glider slump. The National Glider Association, of course, has led only those clubs and individuals affiliated with it. It has had its hands full, for the association grew from 28 clubs, 51 licensed pilots and 32 machines on Jan. 1, to 60 clubs, 204 licensed pilots and 76 machines on Nov. 25. Outside of the N.G.A. were hundreds of independent clubs and individuals, including many virtually untrained high school boys who lacked experienced leadership. Many of this independent class operated to the distinct detriment of the movement.

Improvement in this situation followed promulgation of the Department of Commerce regulations in June and a general waning of super-enthusiasm. The first direct influence of the federal government had been in March, 1930, when it forbade airplane towing except by special permission. The N.G.A. in November abandoned licensing pilots, leaving this work to the National Aeronautic Association and the Aeronautics Branch.

All the federal rules ace now in effect, except that requiring A.T.C.'s for license. Until July 1, 1931, it will continue to be possible to have a glider licensed on the basis of a visual check by an inspector.

On Dec. 1 the government reported the current glider statistics:

Student glider permits active since July 1	858
Glider pilot licenses active	183
Glider licenses active	83
Gliders identified	1,178
Approved type certificates for gliders	1

Nothing spectacular in design has been developed, but experience has forced a general retirement of the primary glider—on account of structural limitations and dangers in favor of the stronger and more efficient secondary, or utility. This type has an enclosed cockpit and fuselage, and an aspect ratio of not more than 10. While not designed directly as a soarer, it will soar excellently when given favorable terrain and wind conditions, as was demonstrated convincingly at the Elmira meet. We heve learned that structural strength in soarers must not be sacrificed for lightness. A number of mishaps, especially control-surface failures in flight, have emphasized the danger of extreme cutting down in weight.

We appreciate better now the value of designs permitting quick and easy assembly and dissembly. The standard primary type was very disappointing on that score among others. Well-built and efficiently designed trailers also are important to successful operations. Use of a single wheel or a pair of wheels instead of only skids has been found advantageous for auto-towing at airports. Simplicity with strength, of course, must ever be the guiding principle in glider design.

Operating scope has increased with the discovery of the Elmira and California soaring terrains, and there is a new impetus to discover other sites. Operating methods have changed considerably in the light of unfortunate episodes in airplane and auto-towing and in improper instruction practices. The usual practice now is to limit primaries to shock-cord launchings. All auto-towing was looked upon with suspicion at one time but it is now the consensus that if done with proper equipment and in a proper manner it is a safe and satisfactory method of glider instruction.

PROGRESS OF RESEARCH AND INVENTION

By Otto C. Koppen

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THE outstanding research problem of 1930 was the uncontrollable spin, held before the attention of the commercial airplane manufacturers chiefly by the requirements of the Department of Commerce. Whether or not the attitude of the Department toward spinning is ton harsh, there is no doubt that the requirements as to the number of turns an airplane must make in a spin without becoming uncontrollable brought out dangerous characteristics of airplanes that would have otherwise been considered airworthy. The necessity of conforming with the requirements of the Department caused a great deal of research that would not have been touched if they had not existed.

Since spinning is a maneuver of little use in either commercial or military flying, there is no doubt that in the future airplanes will be built so that it will be impossible to spin them under any condition. However, in learning to eliminate uncontrollable spins a great deal of information concerning control and stability at low speeds is being obtained, with ultimate improvement of the characteristics of control in stalled flight.

The influence of spin research is already being felt in the field of design. The practice of locating luggage compartments forward of the center of gravity of the airplane is becoming more common, to the benefit not only of spinning characteristics but also of longitudinal stability under full-load conditions.

The research on spinning now being conducted by the National Advisory Committee for Aeronautics ought to be complete enough to provide all of the necessary design data to make it possible to avoid spinning troubles in the future.

Closely allied with the problem of spinning is the question of lateral control at low speeds. In general, an airplane will maintain equilibrium or can be held in equilibrium if the airplane is either stable or controllable. If an airplane is both unstable and uncontrollable, it will not tend to return to its equilibrium position if disturbed and the pilot will have no power to make it do so. Consequently, the motion will increase indefinitely or until a state of motion is reached in which the airplane becomes stable.

The Guggenheim Safe Airplane Competition held early in 1930 brought forward a comparatively new solution of the problem of lateral control. The airplane which won the Competition, the Curtiss Tanager, was equipped with floating ailerons especially designed to provide control at low speeds. The method used was one thet had been tried in England prior to 1924 on an experimental airplane but at that time did not show sufficient merit to justify further development.

The floating aileron as designed by the Curtiss Company proved to be very effective in flight at low speeds. Due to the freedom of rotation of the floating ailerons, when displaced, their angle of attack to the relative wind is equal to the angle through which the pilot moves them, regardless of the angle of attack of the airplane. Since the setting of the ailerons with neutral stick position is always parallel to the direction of the relative wind, the air forces on the ailerons, when displaced, are equal in magnitude. Therefore the drags of the ailerons are equal, and the aileron yawing moment is always equal to zero. The lift of the floating aileron is independent of the lift of the wing, as the function of the aileron is entirely separated from the function of the wing. The rolling moment of the floating aileron is independent of the angle of attack of the airplane wing and varies only with forward speed.

The Guggenheim Competition also practically demonstrated, for the first time in the United States, the marked increase in performance that can be obtained when slots and flaps are used to increase wing lift.

The development that will probably turo out to be the most important of 1930 was not the direct and designed result of research or invention. It was an unexpected outcome of the Guggenheim Competition. The Competition showed that at least two of the entrants, the Curtiss Tanager and the McDonnell "Doodlebug," could be safely landed from any altitude by merely holding the controls back and waiting for the airplane to land itself. That very useful characteristic was due to a combination of wing slots and flaps, sufficient control, and long-travel landing gears, especially the last.

AIRPLANE structural research in 1930 was concentrated chiefly on the design of metal structures heving stressed skin. Allowable stresses in thin metal sheets and the effect of stiffeners on the allowable stresses in thin metal sheets were studied in the laboratories of the Bureau of Standards, of Leland Stanford University, and of the Massachusetts Institute of Technology.

Additional information as to the maximum loads obtained in flight on a pursuit airplane, as yet unpublished, was obtained from pressure distribution tests made by the National Advisory Committee for Aeronautics. Loading schedules now used in stress calculations will no doubt be revised as a result.

PROGRESS IN AIRCRAFT MATERIAL DEVELOPMENT

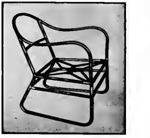
By J. B. Johnson
Chief, Materials Branch
Materiel Division Army Air Corps

IMPROVEMENTS in design are often preceded by the development of new materials of construction, or more efficient methods of fabrication. The aeronautical engineer does not have a background of precedent upon which to base his selection and is more apt to exploit the possibilities of new materials than are engineers in other fields. Progress in the past year has been as notable as in any previous period, despite the curtailment of production. The greatest effort is being directed toward metal construction. Most engineers recognize this as the ultimate goal, although they may advocate other forms of construction as a matter of expediency. The rigid metal wing and fuselage, in which the outer covering is not parasitic but carries its share of the load, is rapidly being realized. The metallic materials which are now commercially used in this country are stainless steel and aluminum alloys. Magnesium is coming to the front in Europe. Beryllium is still on the speculative horizon.

CLEAR, straight-grained Sitka spruce was at one time the principal material for wing beams, but it has gradually been replaced by laminated and built-up construction, except for small, light airplanes. Increased efficiency in the use of material has been obtained in box beams and other hollow structures by the adoption of two-ply spruce or mahogany in place of three-ply material. The planking is made with a glue shear strength equal to that of regular aircraft plywood. With the increase in speed, there has been a tendency on the part of several companies in the past year to use plywood covered wing surfaces in place of fabric, in order to obtain greater stiffness without resorting to metal.

There has been little change in methods of fabricating wood structures. Experiments made at Wright Field on the use of staples applied with a stapling machine in

Development of materials is one of the most important contributing factors to structural efficiency and weight saving. As head of the Air Corps division devoted to this study, the author of the accompanying article has had long and valuable experience with the problem.



Welded seat of magnesium manganese alloy tubing.

place of brads for joining the members of truss-type ribs were quite successful in reducing manufacturing time without impairing the efficiency of the joint. This method has been adopted by at least one manufacturer.

Practically no changes have been made in the casein glues which are universally used for aircraft construction. The uniformity and water resistance of the present product is quite satisfactory. Since the working life after mixing is an important consideration under certain conditions, a viscosity determination has been incorporated into the government specification which insures a minimum working life of five hours.

THE only change in Grade A cotton fabric for wing coverings has been the production of a smoother material, free from nap. Cotton fabrics with less weight and strength than Grade A are being used for light airplane and glider construction. There has been some experimental work on pre-doped tapes. A braided cotton lacing cord has been developed which is superior to the twisted cord made according to standard specifications. Braided cord will not untwist during the process of lacing the fabric to the structure, and the knot can be made tighter and lies flatter than with the twisted cord.

The Air Corps has been successful in the development of a rayon for parachutes which gives a performance equal to the natural silk fabric now extensively used in service type parachutes. The opening time is about the same as for natural silk, and superior to cotton fabric.

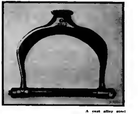
The strength-weight ratio of fine cotton balloon cloth has been raised about 10 per cent.

THERE has been a strong tendency upon the part of airplane designers to use metal construction for aircraft wings. Steel and light alloys have received about equal consideration. Welded truss-type fuselages and control surfaces have been in service for years and are very satisfactory. The construction is rigid and permanent. Looseness or play in the joints is impossible. Fuselages which have been in service for more than six years show no deterioration in the structure. Steel beams made of chrome-molybdenum tubing, oxy-acetylene welded and heat treated, are more recent but have been used in several airplanes. They are especially applicable to the larger types. Heat treatment is generally done after all welding. Material of tensile strength of approximately 150,000 lb. per sq.in. is commonly used.

The use of thin, heat-treated strip steel riveted to form hollow sections has not been adopted in this country, although it is used rather extensively in Great Britain. Test specimens made in accordance with American standards indicate the following physical properties for this material:

Thickness in inches, flanges	0.021
Thickness in inches, web	0.011
Tensile strength, lb. per sq.in.	105,000
Yield point, lb. per sq.in.	128,000
Elongation, in 2 in.	4

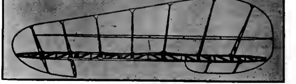
The ingenuity of the designer can find expression to the best advantage in the application of aluminum alloys. The commercial production of extruded and rolled shapes permits a wide choice in the selection of material for built-up sections. The physical properties of the various shapes are generally obtained by heat treatment and are



A cast alloy steel tail wheel fork

quite uniform. For special purposes a higher tensile strength may be obtained by cold working following heat treatment. The only satisfactory method which has been developed for joining the duralumin type alloy is riveting. The heat treatment of rivets has been receiving more attention, as many rivet failures which have been recorded were traced to improper heat treatment. Not only is the strength affected, but also the corrosion resistance. Several factories have adopted the practice of holding rivets at low temperatures after quenching in order to retard aging. Soft iron rivets with a solid or semi-hollow shank are used satisfactorily. Encouraging progress is being made in the welding of high strength alloys, but has been used only for very low stressed parts.

Corrugated and flat aluminum alloy sheet is becoming more popular for wing covering, with a preference for the latter in the more recent designs. A flat, smooth, rigid surface for wings and control surfaces and a monocoque construction for fuselages is possible with metal covering. It is not subject to the change in atmospheric humidity or soaking in water which may cause wrinkling and change of shape in plywood. Fatigue under vibra-



A spot welded stainless steel rudder structure weighing 6½ lb., and load tested 35 lb. per sq.ft.

tion is a matter of design. It can be eliminated with proper attention to the factors which cause breakdown in fatigue, such as rough rivet holes, surface scratches and large unsupported surfaces of thin sheet which permit excessive vibration

The use of heat-treated aluminum alloy castings which have relatively high strength and ductility is increasing with the confidence which has been gained after several years service testing The castings when put into service have a tensile strength of approximately 30,000 lb per sq in. and an elongation of 6 per cent. As aging proceeds, the strength increases and the ductility becomes less, but the rate of decrease in ductility is very slow and there is on case where it has impaired the usefulness of the casting up to a period of five years, which is about the maximum life of any casting now in service

The development of heat treated alloy steel castings is showing interesting possibilities in connection with large airplanes Castings can be made with a wall thickness of $\frac{3}{32}$ in. which have a minimum tensile strength of 100,000 lb per sq in and a minimum elongation of 20 per cent. Such castings are especially applicable to landing gear and tail skid structures

Corrosion - resistant steels beve been receiving more attention in the past year The greater uniformity obtained in this material by improved mill practice has produced a material which is highly resistant to corrosion, weldable and of uniform physical properties. The composition which has proved most satisfactory contains 18 per cent chromium and 8 per cent nickel as the principal alloying constituents It is produced in the form of annealed and cold rolled sheet and strip, bars, tubes and wire. Seamless and oxy-acetylene welded tubes are being used for exhaust manifolds and a few structural parts. Sheet and strip is being used for exhaust rings and structural parts, such as ribs and experimental wing beams An interesting development in this connection is the use of spot welding for joining the several members of a small truss, such as a wing rib The ribs are built up of a series of channels manufactured from a strip with a tensile strength of 180,000 lb. per sq in. There is some reduction in strength due to welding at a single spot, but the efficiency of the joint can be raised by using several spots spaced as rivets would be. There is some reduction in corrosion resistance by welding, but any corrosion that appears is more in the nature of a staining of the steel than actual pitting. It can be overcome to a large extent by pickling to remove the scale and then passifying.

Stainless steel is especially satisfactory for external tie rods which are subject to corrosion. A high polished, pickled and passified stainless steel tie rod has from three to four times the corrosion resistance of a cadmium-plated tie rod as measured by the salt spray test. Such a rod is practically immune to any corrosion fatigue, and there is little danger of an abrasion causing rapid deterioration Stainless steel wire is also being manufactured into control eable The fatigue resistance of such eable is equal, if not superior, to that of high carbon steel wire used in the standard cable.

Copper has been the material selected for fuel, water and oil lines with very few exceptions The weight of this piping becomes appreciable on large, multi-engined airplanes and a number of installations have been made using aluminum and in some cases aluminum alloy tubing These have been uniformly successful Failures can generally be traced largely to inadequate fittings Aluminum has a lower fatigue limit than copper, nickel or other beavier metals, but if the line is properly supported the stresses are low and the life of aluminum is equal

Application of magnesium-manganese alloy sheet to welded tank construction.

to that of any of the heavier materials The majority of failures in fuel lines can be traced to abrasions of the surface at the fittings which have a very serious effect on the life of any metal under vibration.

The use of magnesium alloys in airplane construction has been restricted in this country on account of the corrodibility of thin sheets and tubes Much more extensive use has been made of this material in Europe due to the fact that a more corrosion-resistant material has been developed It is being used especially for cowling, fuel tanks, and seats, although experimental wing and fuselage structures are also being flight tested Tanks and seats are welded Cowling is riveted. Magnesium alloy castings have been used to some extent in this country on aircraft engines, but the high price has limited their appliestion These castings have a strength and ductility equivalent to heat-treated aluminum alloy castings Corrosion resistance of the magnesium-aluminum-manganese cast material is quite satisfactory. Extruded and formed magnesium alloy propellers show considerable promise, as the ratio of fatigue limit to weight is higher than in the case of aluminum alloys.

Nitrided steel has been used to a limited extent for certain engine parts and its use will probably be extended as it becomes more generally available It has very great hardness and excellent resistance to salt-water corrosion, properties much to be desired in clevis pins, hinge bolts and similar parts.

AMERICAN AERONAUTICS ABROAD

By
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During the year 1930, American aeronautieal companies in foreign fields have been courageous and vigorous pioneers, willing to back up their imagination and confidence by laying foundations for the future without immediate financial return in view Never has an American industry seriously set out to make a reputation for itself in foreign fields at so early an age.

In the field of air transport, there were on Nov. 20, 1930, in regular operation by American companies running beyond the borders of the United States, 19,594 miles of air lines The comparative figure for Jan. 1, 1929, was 1,169 miles In addition, there were in November, 1930, 4,941 miles operated by companies controlled by American capital. The Pan-American System (Pan American Airways, Pan American-Grace Airways, and Mexican Aviation Company) is the largest single undertaking This line started late in 1927 with a round trip daily between Key West and Havana, a jump of some 110 miles On Jan. 1, 1930, the planes of this system flew 8,113 miles a day on a system of 11,873 miles; and in November, 1930, they were flying 12,074 miles a day on an enlarged system of 18,004 miles

The planes of the New York Rio and Buenos Aires, or Nyrba Line, another American company, were flying an average of 1,953 miles a day on 2,250 miles of lines centered at Buenos Aires, on Jan 1, 1930 Late in September, 1930, these two companies, the Pan American Airways and the New York, Rio and Buenos Aires Lines, merged their interests into the Pan American Airways System. Some of the Nyrba services were discontinued, but there is little doubt that within a reasonable time the Pan American Airways will be operating complete services along the east and west coasts of South Americs, as well as numerous intermediary and feeder lines Accurate traffic figures are scarce, but on Oct 1, 1930, the records of the system showed a total of 5,344,447 miles flown, with 30,727 passengers, 511 tons of goods, and 580 tons of mail carried The passenger traffic on the U.S.-owned lines in South Americs totaled 10,715,000 passenger miles for the first six months of the year.

During 1930, lines participated in by the Curtiss Company and the Chinese Government operated a distance of 550 miles from Shanghai to Hankow, or 1,100 miles per day of flying. This line was for the purpose of carrying mail and passengers, and encountered some difficulties with competing departments of the Chinese government, but late in the year these difficulties were solved and operations are now on a sound and clearly understood basis and plans for extensions are on the way.

In the field of exports of aircraft and equipment, the United States has, during the year 1930, practically maintained the record pace set for the previous year This is a remarkable performance in the face of the striking

American aeronautical equipment is steadily finding its way into foreign fields, and transport operators of the United States are extending their activities aborad. The past year has been devoted largely to ground work in developing a very promising export market.

decline in export trade in nearly all other commodities which has taken plare during the year It has been estimated that the exports of all United States products during the first nine months of 1930 were about 23 per cent under those for the same period of the previous year, whereas exports of aeronautical equipment were only 5 per cent less Total foreign shipments of aircraft, engines and parts from the United States during the first nine months of this year were valued at $6,783 123, as compared with $7,130,916 for the same period in 1929 This involved the exportation of 251 complete aircraft at a valuation of $3,740 082 compared to 275 complete aircraft valued at $4 397,311 during the same period in 1929 Engines exported during the January-September inclusive period this year numbered 294 valued at $1.289 343, being 29 more in number and $162,253 greater in value than those exported during a similar period the previous year The exports of parts for the nine months' period of the current year were valued at $1 753,698 compared to $1,606,515 for the same period of last year.

United States airline activity in South and Central Americs had an immediate effect on the shipment of American aircraft to those districts, which were responsible for 54 per cent of our exports as compared with 38 per cent for the whole of 1929 One of the largest American aviation companies sent a demonstration mission to Europe, which included a pursuit, an observation, a training, and a light cabin airplane Regardless of whether the company in question receives orders sufficient to offset the cost of the demonstration mission, it will have rendered an outstanding service to the American aeronautical industry in general, enabling Europe to see in action first-class American products This kind of salesmanship is worthy of support by all.

One of the leading manufacturers of multi-engined transport planes continued its demonstration tours in Europe and the Far East with unexpectedly successful results Whereas the tours were originally undertaken largely for advertising, sales of some fine demonstrating planes are reported to have resulted

Another demonstration mission was conducted in South America by another American company with light open biplanes of a strictly commercial type One of these planes, a 165 hp model, flew the forbidding Andean hump between Chile and Buenos Aires without difficulty Results were the sale of both demonstration planes and good prospects for eventual business

There were a number of American pursuit planes exported early in the year for the use of the Netherlands East Indian Air Forces Some American high-powered engines are now being installed in pursuit planes of American design in Siam During the year a licensing agreement was effected for the fabrication of these American planes in a Siamese government factory, engines to be continued to be exported The Japanese market, as in the case of other lines of mechanical equipment, is confined almost exclusively to manufacturing licenses, which invariably means that several units of the product to be manufactured are exported

Actual military sales in China were made in substantial number by one of the leading American companies

During 1930, American engines were manufactured in Germany for the first time and further activity along these lines is pending in other European countries as a result of licensing arrangements completed during the year In South America, one American firm began the erection of a branch factory in Chile, to be devoted almost entirely to military production

Several important foreign aeronautical missions visited the United States during the year. General Quinones, head of the aviation unit in the Colombian Army, and Captain Benjamin Mendez, visited this country after an inspection of European factories, and investigated various aeronautical activities in the eastern part of the United States Mr Georges Garbe, head of the airport department of the French Air Ministry, made a tour of most of the outstanding airport developments in the United States A group of four European pilots came to this country and took part in the Chicago National Air Races with conspicuous success.

More interest is being shown in aeronautical exhibitions abroad and in international conferences The industry was represented through the Department of Commerce at the International Aviation Lighting Meeting at Berlin, at the Fifth International Air Conference at the Hague, and the International Air Safety Conference at Paris

There are now pending negotiations, carried on by the Department of State, for aircraft licensing arrangements with most of the European countries similar to those now in effect between the United States and Canada, the United States not yet having seen fit to ratify the International Air Convention of 1919. For purposes of comparison, examination of the record shows that during the first five months of 1930, France exported complete aircraft valued at $3,215,000 as compared with our $2,042,223 During 1929, Germany exported 150 planes valued at $1,681,905 and the United Kingdom exported aircraft and parts valued at $10,538,625 as compared with our $9,202,380.

On the whole, from the point of view of activity of American aeronautical interests abroad, the year has been distinctly encouraging It has shown that American air lines are furthering their international activities in accordance with a comprehensive program with the assistance of the Post Office Department and the Air Mail, and that American aircraft exporters have taken the long-time view of export activities which is absolutely necessary for eventual success.

A Consolidated Fleetster as used in South American transport service.

AERONAUTICAL FINANCE IN 1930

By R. R. Doane

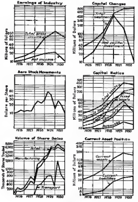
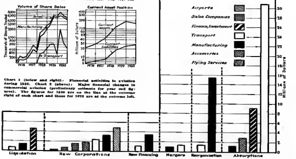


Chart 1 (below and right): Financial activities in aviation during 1930. Chart 2 (above): Major financial changes in commercial aviation (preliminary estimate for year end figures). The figures for 1930 are on the line at the extreme right of each chart and those for 1926 are at the extreme left.



THE year 1930 will long be remembered in aeronautical business circles not alone for its sharp contrast with the two years of unrestrained development which preceded it, but for the pitfalls and dangers inherent in a general state of trade for which this industry had but little responsibility.

In a period which has rapidly developed into a major economic crisis of world-wide proportions, the capital structure of the American aeronautical industry has withstood the strain astonishingly well and now bids fair to come through into the calmer sea of moderate prosperity with comparatively few fatalities

In carefully reviewing the chronology of the corporate events of the past year, one cannot help being forcibly impressed by the small number of enforced liquidations. In what has been universally considered the costliest year yet experienced by commercial aviation, with a 55 per cent reduction in productive output and a 40 per cent

Table 1: Chronology of Major Financial Changes in the Aeronautical Industry During 1930

Company	Division	Character of Change	By	Terms	*Amount Involved	Period of Year
Edo Aircraft Corporation	Manufacturing	New financing	Company	Increase in capital stock	$250 000	January
Aero Corp. of California	Transport	Absorption	Western Air Exp.	1 sh. W.A.E. for 12 shs. A.C. of C	1 648,000	January
Bragg-Kliesrath Corp	Accessories	Absorption	Bendix Aviation	Not reported		February
Airstocks, Incorporated	Investment	Liquidation	Company	Dissolved by White, Weld & Co.	4,235,000	February
Aeronautical Industries, Inc.	Investment	Absorption	National Aviation	½ sh. N.A. for 1 sh Aero Inc.	1,350 000	March
National Aviation Corp.	Investment	Stock increase	Company	Increased capital stock 600 000 shs.		March
Airparts & Tool Corp	Accessories	Absorption	Ex-Cell-O Aircraft	⅓ sh. XLO for 1 sh A. & T. 1 & 1 for 3**		March
Airships, Incorporated	Manufacturing	Bankruptcy	Voluntary petition	Voluntary petition in bankruptcy	15,000	April
Kansas City Aircraft Co.	Manufacturing	Consolidation	Bird Wing Aircraft	Capital increase $000 000	500 000	April
Knoll Airplane Co	Manufacturing	Bankruptcy	Yellow Air-Cab Co.	Purchased from receiver	166,500	April
National Air Transport	Transport	Absorption	United Aircraft	1 sh. U A & T for 3 shs. N.A.T	20 000 000	May
Command-Aire, Inc	Manufacturing	Bankruptcy	Voluntary	Petition by president of company	(No schedule)	May
MacKenzie-Morrow Aviation	Sales-Service	Merger	American Aircraft	Details not reported		May
Dungan Airways, Inc	School	Absorption	Wings, Inc.	Details not reported		May
Aviation Corp. of Del	Holding Corp	Recapitalization	Company	Reduction from 10 to 5 mil. shs		May
Fairchild Aviation Corp.	Manufacturing	Recapitalization	Company	Sale of Aviation Corp. holdings	1,434 000	May
Aviation Corp. of Cal	Holding Corp	Absorption	North Am Aviation	Share for share exchange 100 000 shs	1 000 000	May
Los Angeles Metro. Airport	Airport	New financing	Company	$000 000 7% pfd $1 assessment per sh	000 000	May
Fokker Aircraft Corp.	Manufacturing	Recapitalization	General Aviation	Increase of 4 million no par shares		May
New York, Phila., Wash A.C	Transport	New Corporation	Company	Privately financed	1,000 000	June
Great Lakes Aircraft Corp	Manufacturing	New Financing	Company	100 000 shs Class "A" stock	000 000	June
Consolidated Instrument	Accessories	Absorption	Bendix Aviation	1 sh Bendix for 12 shs. Consolidated	492,400	June
Alliance Aircraft Corp	Manufacturing	Bankruptcy	Involuntary	Sold by receiver to Warrior Aero Co.	39 319	June
National Aircraft Products	Accessories	Absorption	United Acft Prod	Increased capitalization	000 000	June
Berliner-Joyce Aircraft	Manufacturing	Absorption	North Am Aviation	1 sh N A A for 2 shs. B-J	650 000	June
United A & T of Conn	Management	New Corporation	United Aircraft	All stock owned by United Aircraft	12,000 000	July
Davis Airlines, Inc	Transport	Bankruptcy	Petition	Involuntary petition in bankruptcy	000 000	July
Varney Air Lines, Inc	Transport	Absorption	United Aircraft	1 sh. U. A. & T for 2 shs. Varney	300 000	July
Cessna Aircraft Corp.	Manufacturing	Reorganization	Voluntary	No schedule reported	275 000	August
Kinner A & M Corp	Manufacturing	Recapitalization	Company	10 old $1 shares for 1 new no par		August
Pheasant Aircraft Corp.	Manufacturing	Absorption	Dayton A & E Co	No details reported		August
Continental Air Express	Transport	Absorption	First Nat'l Airways	Details not reported		August
N Y , Rio & Buenos Aires	Transport	Absorption	Aviation Corp. Am	1 sh Pan Am for 5½ shs. NYRBA	4,000 000	August
Crescent Aircraft Corp	Manufacturing	Bankruptcy	Involuntary pet	Receivership liquidation	(No schedule)	August
Aviation Credit Corp	Finance	Absorption	Commercial Credit	$23 per share	5,175,000	September
Doyle Aero Corp	Manufacturing	Bankruptcy	Involuntary	Petition in bankruptcy	(No schedule)	September
Brower Air Service, Inc.	Transport	Absorption	Western Air Service	Details not reported		September
Brunner-Winkle	Manufacturing	Reorganization	Bird Aircraft Corp.	Reorganized under name Bird Aircraft		September
Washington Airport	Airport	Merger	Hoover Field	Details not reported		September
Stout Air Services, Inc	Transport	Absorption	N A T	Details not reported		September
New Eng. & Western Air Trans	Transport	Absorption	General Aero Corp.	Details not reported		September
American Eagle Aircraft	Manufacturing	Recapitalization	Company	Sh. reduction 10 old for 1 new	**000 000	September
Southwest Air Fast Express	Transport	Merger	Robertson Aircraft	Controlled by Aviation Corp of Del		October
Eagle Airlines, Inc	Transport	Liquidation	Voluntary	Petition in bankruptcy	(No schedule)	October
Transcont. & Western Air, Inc	Transport	New Corporation	W.A.E. & T.A.T.	Equal stock interest both companies	(No data)	October
Mohawk Aircraft Corp.	Manufacturing	Liquidation	Voluntary	Taken over by R. R. Rand, Jr		October

*Estimated at prevailing market price for securities at the time. **Now 6½% 15-year notes.

Table 1A: Aeronautical Finance During 1930

	Manufacturing	Transport	Accessories	Holding and Investment
Absorbed	Berliner-Joyce, Pheasant Aircraft	Aero Corp. of Cal. N. A. T., Varney Air Lines, Continental Air Exp., NYRBA Lines, Brower Air Service, Stout Air Services, New Eng. & Westn. Air, Southwest Air Express	Bragg-Kliesrath, Airparts & Tool, Consolidated Inst., Nat'l Air Prod.	Aero Inc., Inc., Av Corp Cal. Av Credit
Capital changes	Edo Aircraft Corp., Fairchild Aviation, Fokker Aircraft, Great Lakes Aircraft, Kinner A. & M., American Eagle	Aviation Corp. of Del., Aviation Corp. of Am., Western Air Express	Ex-Cell-O A. & T	Nat'l Aviation, North Am. Av
Reorganized	Cessna Aircraft, Brunner-Winkle			
Consolidated	Kansas City Aircraft	Robertson Aircraft		
Liquidated				Airstocks, Inc.
Receivership	Airships, Inc., Knoll Airplane Co., Command-Aire, Inc., Crescent Aircraft, Doyle Aero Corp., Alliance Aircraft	Davis Airlines, Inc.		
New companies formed	Inland Aircraft	N. Y., Phila., & Wash., Thompson Aero, Trans. & Western Air		
New financing	Edo Aircraft, Great Lakes Aircraft, American Eagle Aircraft	Aviation Corp. of Am.		North Am. Av

curtailment of total income, only nine relatively unimportant aircraft companies have been forced to seek the protection of the bankruptcy courts. Total assets of less than $1,000,000, or one-fifth of one per cent of the total assets of the industry, have been involved. And this high degree of solvency has been maintained despite the fact that during almost the whole of 1930 the rumormongers were busy setting up phantom receiverships among the industry's most important units.

Major Capital Changes of Year

THE major constructive financial events of the year were confined almost wholly within the transport division, where, due to competition for strategic properties, assets valued in excess of $10,000,000 were absorbed at current prices in excess of three times that amount. Absorptions and further consolidations, with but few exceptions, were absent from the aircraft manufacturing field. There was, however, among the manufacturing corporations a considerable tightening-up of the capital structure, with an eye to the immediate lean period of earnings and to a greater facility for possible future consolidations and new financing. There was also a knitting together of the accessories field during the first part of the year, with a decided tendency in the same direction on the part of finance companies.

A glance at the accompanying Table 1, with its supplementing tables A, B, and C, supplies an adequate and comprehensive digest of the principal corporate changes and activities of the year. The full significance of the

Table 1B: Classification of Corporate and Financial Changes in 1930

(000 omitted)

Character		Manufacturing No.	Manufacturing Amt.	Transport No.	Transport Amt.	Accessories No.	Accessories Amt.	Finance No.	Finance Amt.	Total No.	Total Amt.
Mergers	Absorption	2	$1,225	9	$30,000	4	$2,000	3	$9 125	18	$45 150
	Consolidation	1	1,000	2	1,450	0		0		3	2,450
Reconstruction	Recapitalization	4	15,250	1	650	0		0		5	15,950
	Reorganization	3	675	0		0		0		3	675
Liquidation	Dissolution	0		1	75	0		1	4,236	2	4,311
	Receivership	7	671	2	250	0		0		9	921
*New incorporations		14	3,255	12	2,847	5	000	3	325	34	6,127

*Totals for new corporations do not include figures for flying services, airports, and sales companies as found in Table 1C.

Table 1C: New Aeronautical Corporations

Classification	Number	Capitalization
Manufacturing	19	$3,254,000
Transport	12	2,047,000
Flying service	44	1,994 000
Airport	10	4,275 000
Finance	3	325 000
Sales	39	1,735,000
Totals	127	$13,630,000

This tabulation is taken from the total number of new corporate charters granted by the various states during the year. The total capitalization figures are for the amounts authorized in the original articles of incorporation and should not be construed to mean that an equivalent amount of new capital has yet found its way into these enterprises.

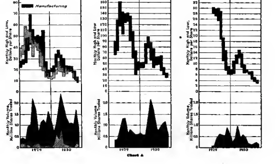


Chart 4

major financial changes can be more graphically seen in Chart 2, which summarizes the entire industry. Chart 1 graphically portrays the relative activity, in dollar terms, of the major changes as set forth in Table 1.

Aeronautical Stock Movements

REFLECTING more faithfully the predominant trends of the entire speculative securities market than the individual fortunes of the many companies they represent the aviation stocks close the year 1930, on the whole, at levels considerably lowet than those at which they stood at the beginning of the year.

Chart 3 gives the main trends during the past 24 months of both the transport and manufacturing aviation stocks, together with their volume of sales. From a study of the chart of stock averages and the trend in volume of sales it appears that considerable liquidation has been in process during the latter half of the year. The high and low monthly movement and volume of both United Aircraft and Curtiss-Wright are included separately in chart form in order that the faithfulness to general trends, regardless of present differences in earning-power and net working capital position, may be the more vividly observed.

Very little evidence of discrimioation between aircraft security values has yet manifested itself. There are instances of aero stocks which dropped during 1930, 75 per cent below their average 1929 price level, while at the same time the companies they represent greatly increased their income during the same period. Selectivity, apparently, has little part to play in a market ruled by fear.

Aeronautical Earnings of 1930

WITH the exception of those spectacular losses which have occurred as a result of excessive inventory, over-capitalization, and what has appeared as excessive commitment in fixed and non-liquid assets, there has been a far greater stability to aeronautical earnings during 1930 than is popularly supposed. In the transport field the year's earnings, with but one exception, have been considerably better than those for 1929. In fact the average increase in gross for 1930 over 1929 stands at approximately 18 per cent. Due to increased passenger traffic and express, together with the increased rates effective during the latter portion of the year, a proportionate improvement in net earnings may be expected when the final reports are compiled.

Airport holding and operating companies are showing uniformly better earnings than a year ago. The Cleveland Municipal Airport reports gross income at the rate double expenses; the City of Newark estimates that it will net $50,000 on the Newark Airport, for the year's operations; and these are merely samples.

In the manufacturing field two prominent companies have passed the year with undiminished earnings, while three well-known companies have practically doubled their volume of business over 1929. Those companies specializing in government work have fared uniformly well during 1930. In fact they have, despite the general depression throughout the industry, been able to show a substantial increase in their gross income with a proportionate increase in net.

Based on the aggregate reports now available there can be no doubt but that 1930 has proven, from the quantitative financial standpoint, the worst year yet encountered in the brief history of commercial aviation. But a

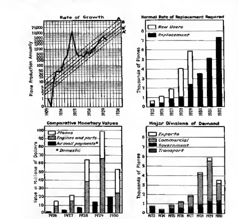


Chart 4: Underlying factors behind the present financial structure of aviation.

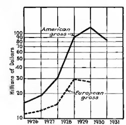


Chart 5

large portion of these losses have been but the necessary accompaniment of an exaggerated and highly inflated investment promotion.

Plant Consolidation

CONTRARY to many forebodings, the economies already effected and still likely to be realized through consolidation have not been over-emphasized. There are instances, of course, where they are likely to prove as disappointing as in some other industries. The degree io which manufacturing aod operating costs may be reduced through unification of facilities and equipment may be expected to vary with conditions in the several sections of the industry. On the whole, however, such benefits may be expected to be a large and important contributing factor making inevitably for a better earnings record in the future.

Inadequacy of Depression Remedies

FROM more than one standpoint there is evidence that the aeronautical industry's critical period, like its best times, still lies ahead. It is manifestly unfair to lay too much at the door of mismanagement within an industry whose progressive plans were temporarily arrested by external trade developments so obviously beyond its control. Yet the plans and commitments were made, and the essential correctives must be undertaken in order to meet the new condition.

There is evidence that this preparedness is, at the beginning of 1931, still somewhat far from complete. The liquidation of inventories and of unprofitable fixed assets has been not altogether as satisfactory as it might have been. It also appears thet some of the remedies thet have been effected have been of the makeshift variety.

However this may be, the question, so far as those directly interested in aviatioo are concerned, resolves itself into the extent and duration of probable declines in total commercial aircraft production, and of the effect upon the profits which these companies will be likely to earn.

It appears reasonable to assume that the answer to the above depends in large measure upon whether the conditions of the crisis-breeding cycle, started by the accelerated productivity of 1928 and 1929, are to continue. These conditions are familiar to all. They are first: a rapid rise in output as a result of the public's increased interest with the attendant inflation of inventories. Second: capital waste and inefficient employment of funds as a result of over-competition and under-co-operation which made for unbalanced production. Third: Fundamental market situation which became strained because the productive plant equipment had become too large for the demand base upon which it rested. Fourth: the growing lack of liquidity of working assets because of a too large investment in fixed capital. Fifth: the necessity to maintain an adequate liquid position io the face of rapid adjustments and continued high fixed costs.

The past year has supplied us with a clear example of the necessity of the essential corrective measures that this cycle requires. It has not, however, supplied any convincing demonstration that they have been completed.

Stability of Export Trade

THE continued drive in the export field has proven a marked help during the past year. According to Department of Commerce figures $6,214,720 worth of aeronautical goods were exported during the first eight months of 1930. Both engines and parts exceeded slightly the 1929 export figure covering the same period, while exports of planes were only three units behind. In view of the generally unsettled international trade conditions this is indeed a splendid record, and speaks well of the developing export business as an added element of stability in the total annual aircraft demand.

Table 2: Three-Year Comparative Division of Income
(000 omitted)

	1928				1929				1930*			
	Net		Loss		Net		Loss		Net		Loss	
	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.
Holding companies	5	$6,014	0		4	$11,835	3	$2,845	2	$4,234	2	$11,181
Manufacturing companies	12	3,951	2	$204	10	3,213	6	592	4	2,631	4	2,162
Transport companies	2	909	0		2	1,758	2	1,304	1	347		
Airport companies					1	11	1	19				
Finance companies					2	415	0					
Investment companies					2	368	0				1	1,747
Totals	19	$10,874	2	$806	22	$17,598	12	$4,760	7	$7,212	7	$15,090

*9 months ended Sept. 30, 1930.

Commercial Aviation Abroad

DESPITE the more or less pessimistic report made to the Commission of Civil Aviation Experts which met last October at the League of Nations, available earnings reports of outstanding European aeronautical companies indicate a surprising vigor of growth. The accompanying Chart 5 discloses an astonishing resemblance, with the exception of 1929, of the major income trends of European companies to those experienced by the outstanding companies within our own country.

FLIGHTS, COMPETITIONS, AND RECORDS

Wasp powered Laird "Solution," winner of the Thompson Trophy race

PROBABLY it will be remembered as a climax, this year 1930. Assuredly, the year gave us an ample number of trans-Atlantic and transcontinental flights, refueling flights, competitions, and miscellaneous stuntery. But there was a new note in them. In Paris, following his trans-Atlantic flight, Coste said: "I think we are about the last of the public's airmen heroes. Had we waited another year nobody would have turned out to welcome us anywhere."

Another approximate climax lies in Frank Hawks' transcontinental trip of 12½ hr., and that of Ruth Nichols last month, which fell one hour short of Hawks' record. Now we await a commercial application. All that can be proved by duration refueling flights seems to have been proved by Jackson and O'Brine in their 647-hr grind above St. Louis—certainly it showed the satiation point had been reached as far as promotion money-making was concerned—and that is a pleasing note.

The industry began to look to the knell of the ballyhoo period. Above all, it cried out against the over-emphasis of stunting. There was the statement by Curtiss-Wright Flying Service: "This organization is in business to provide flying instruction and airplane transportation. Racing has no connection with the commercial operation of airplanes." The commercial manufacturers of airplanes, through the Aeronautical Chamber of Commerce, went on record against acrobatic exhibitions. The industry is girding itself to rise from the depression as an industry,—and not a show.

Under the head "Trans-Atlantica," heavier-than-air, outstanding was the Paris-New York flight, non-stop, of Coste and Bellonte in the Breguet Question Mark—a flight which strikingly simulated the New York-Paris dash of Lindbergh, this time in the reverse, and more arduous, direction. The Frenchmen made the trip early in September, in 37 hr. 18 min.

Two east-west North Atlantic crossings preceded this. In late June, Major Kingsford-Smith and three companions flew in the veteran rebuilt Fokker F-7 Southern Cross (three Wright J-5's) from Port Marnock, Ireland, westward across the Atlantic to Harbor Grace, Newfoundland. A feature of the flight was the employment of radio-transmitted weather data to aid navigation through thick weather encountered near the American coast. The other crossing was that of Capt. Von Gronau and his crew of three in the two-engined Dornier Wal flying boat formerly operated by Captain Courtney. Covering a nine-day period in August, it started as a German flying school training flight—but ended at New York City! From Isle of Sylt, in the North Sea, the trail led by Faroe Islands; Reykjavik, Iceland; Ivigtut, Greenland; Cartwright, Labrador; Queensport, Nova Scotia; Halifax; and New York.

Thus, 1930 saw three successful westward crossings to balance the many eastward flown in other years. Incidentally, there was one eastward flight, too—that of Boyd and Connor in the Bellanca Columbia, which had already crossed the Atlantic in '27.

In the South Atlantic field, a very interesting commercial flight was made when Jean Mermoz, with co-pilot and radio operator, flew from St. Louis, Senegal, across the ocean to Natal, Brazil, in a single-engined Latecoere seaplane. He carried 308 lb. of mail, which was thus routed by the Aeropostale companies' planes from Paris to Rio de Janeiro in about three and a half days. The trans-Atlantic distance was set at 1,990 mi. and the time of the flight 20 hr. 15 min. Later, Mermoz attempted to repeat his flight in the other direction with 600 lb. of mail, but he was forced down and taken aboard one of the Aeropostale company's guard boats.

Twice, Bermuda and New York were connected by air. In April, Captain Yancey and two companions flew a pontooned J6-9 Stinson Detroiter to within 60 mi. of the island goal, landed on the sea and then completed the flight next morning. Another venture in aviation to the same small target was the round trip made by Roger Q. Williams, with Mr. Connor as co-pilot and navigator, in June. The round trip consumed but 17 hr. The plane—again—was the Whirlwind Bellanca Columbia.

LIGHTER-THAN-AIR crossings of the Atlantic numbered four in '30—round trips of the Graf Zeppelin and of the R 100. The former flew from Germany to Seville, Spain, then crossed the ocean to Pernambuco, Brazil, in 62 hr. From there a round trip to Rio de Janeiro was made, then the dirigible flew north to Lakehurst, New Jersey. The airship left Germany May 18 and landed at Lakehurst May 31. The Graf then was flown back across the North Atlantic again to be moored at Friedrichshafen on June 6. Dr. Eckener stated that the flight proved the airworthiness of his giant in equatorial climates. Many flights were made with the Graf in Europe.

After several delays, the British R 100 finally took off from Cardington, England, July 28, and was flown to Montreal, Canada, in the time of 78 hr. 52 min., landing at the latter point Aug. 1. A visit was made to

Toronto, following repairs to a fin damaged in the ocean crossing. Then came the return to England—a flight of 57 hr. British lighter-then-air projects, encouraged by these performances, suffered a sad blow later in the year, for on Oct. 5, the R 101, sister ship to the R 100, was wrecked at Beauvais, France, during an empire flight to India, and nearly all on board were lost, including most of England's leading lighter-than-air exponents.

The Hispano powered Breguet sesquiplane "Question Mark" flown by Costes and Bellonte.

Mention may be made of an Atlantic attempt begun but not completed—that with the twelve-engined Do X. She got underway from Altenrhein, Switzerland, her base, on Nov. 5, and flew the first leg of its journey to New York City—the hop to Amsterdam. "Commercial efficiency and flying range will be specifically studied," stated Comdr. Friedrich Christiansen as the flying boat left. The Do X next flew to Calshot, England, on Nov. 10, to pause again until Nov. 14, when the flight to Bordeaux, France, was begun. A late start from Calshot with foggy weather to contend with slowed the craft. Commander Christiansen brought his charge down on the calm sea near Sables d'Olonne, France, when darkness threatened, taxied some 50 mi. down the coast to La Rochelle, and cast anchor for the night.

Then the plane continued to Bordeaux, which lay but an hour and fifteen minutes distant, next to Santander, later Coruña, Spain, and from there to Lisbon, Portugal, on Nov. 27, three weeks out from home. While officials were trying to decide when and by what route the ocean crossing would be made, an electrical short circuit on Nov. 29 started a fire which was not checked until one entire wing was ruined. Thus the Do X lies at Lisbon under repairs.

We now turn to another "Trans-" head—"Transcontinentalia." As usual, the name of Hawks leads all the rest.

Until 1930, records for transcontinental flights between New York and Los Angeles were established non-stop, but pauses en route now become the order of the day. On Easter Day, Colonel Lindbergh, accompanied by his wife, flew from Los Angeles to New York in 14 hr. 45 min., having stopped for fuel at Wichita, Kan. The plane used was a Wasp-powered low-wing Lockheed Sirius. This time was generally considered to be the "last word." But on Aug. 13, Capt. Frank Hawks brought a J6-powered Travel Air low-wing over the same run in 12 hr. 25 min. Stops for fuel were made at Albuquerque, Wichita, and Indianapolis. The Captain had already established a new record in the East to West direction the week previous, when he flew to Los Angeles in 14 hr. 50 min., with five fuel stops.

Brock and Schlee, the Detroit-to-Tokio fliers, and Col. Roscoe Turner turned in two other transcontinental flights of note, both using Wasp-powered Lockheed planes of high wing type. The Detroit airmen flew from Jacksonville, Fla., to San Diego, Cal., in 13 hr. 56 min., paused one hour, then flew back to Jacksonville, with one stop, in 16 hr. 50 min. This round trip of 31 hr. 57 min. elapsed time took place June 17-18. Turner's flight was a "three-flag" venture, in 9 hr. 14 min. from Vancouver, B. C., to Agua Caliente, Mexico.

A word, too, must be given here to Hawk's novel transcontinental glider trip. Towed in a Franklin Eaglet glider behind a Waco plane operated by J. D. Jernigin, Jr., Hawks left San Diego on March 30. He completed the tow flight to New York City on April 6, virtually on time to the minute according to his schedule.

A FEW of the many other flights of the year may be mentioned. To test a two-way radio on a long distance flight, Capt. Lewis Yancey, with Emil Burgin as pilot and Zeh Bouck, radio operator, flew on May 14 from New York in the Wright Stinson-Detroiter (which had figured in his Bermuda flight) for severel weeks of flying in South America. The trip proved highly successful until the plane was unluckily forced down in the West Indies on the return. Then on June 7, Nick B. Mamer set a new mark of 9 hr. 32 min. for the St. Paul-Spokane run in a Wasp Buhl.

Take off of the Do.X on one of its test flights.

In the fall, Hawks again made the headlines with a new Havana-New York record of 8 hr. 44 min. in his Texaco Travel Air. Another flight was Capt. Roy Ammel's 24 hr. 35 min. non-stop flight from New York to the Panama Canal Zone, Nov. 9-10, in a Wasp Lockheed Sirius.

Several flights saw automatic pilots put through their paces. The Sperry unit was used to control a Curtiss Condor during the Army maneuvers on the West Coast

in April, while further tests of the Greene Guardianaire automatic pilot were made by N. A. T. and the Clifford Ball line.

The refueling flight stage for the year—a French publication would have us call it "refuelomania"—was held by Jackson and O'Brine and the Hunter Brothers. The former pair entered 1930 as the record holders, boasting a mark of 420 hr. established in July, '29, in the Challenger-powered St. Louis Robin. They left 1930 still record holders—but with a new mark of 647 hr. On June 11 at Sky Harbor, Chicago, John and Kenneth Hunter took the air in the "City of Chicago," a Wright powered Stinson-Detroiter, and did not again touch earth for 553 hr. This piqued Jackson and O'Brine into leaving the earth for another grind, one which did not end until the present 647-hr. mark was established. A Challenger-engined Robin, "The Greater St. Louis," was employed in this venture.

THICK and fast came new records to be recognized by the F.A.I. in 1930. On Oct. 10, a check showed France held 34 records, the United States 27, and Germany 26.

Among the important marks of '30 were Lieut. Apollo Soucek's new world altitude mark of 43,155 ft. and the new world endurance record, non-refueling, of 67 hr. 13 min. established in Italy by Maj. Umberto Maddalena and co-pilot Lieut. Fausto Cecconi in a 550 hp. Fiat Savoia monoplane. Lieutenant Soucek's mark in his Wasp Wright Apache biplane bettered the record of 41,794 ft. held by Willi Neunhofen of Germany, while Maddalena's effort broke the mark of 65 hr. set by the Germans, Risticz and Zimmerman, in 1928. The Italians also established the world record of 5,050 mi. for closed circuit distance non-stop in this flight.

For maximum speed, Squadron Leader Orlebar's 357.7 m.p.h. stood unchallenged throughout 1930.

The records of Capt. Boris Sergievsky drew the spotlight with striking frequency in '30. With a Hornet powered Sikorsky S-38, minus wheels to give it seaplane classification, Captain Sergievsky attained an altitude of 19,065 ft. with a 2,000 kg. load, then set an average speed of 143.9 m.p.h. over the 100 km. course with the same weight. Later he flew to 23,222 ft. with his load at 1,000 kg.

Hornet engines were then replaced with Wasps, and with this set-up a height of 26,400 ft. was reached with the 500 kg. load and also a height of 19,928 ft. with 2,000 kg., thus breaking his own 19,065 ft. mark. An altitude of 26,929 ft. was reached with 1,000 kg. load later in the year, bettering the previous mark.

Lee Shoenhair, with a Wasp-powered Lockheed Vega, also turned in several new figures. He averaged 185.45 m.p.h. for 100 km. with 500 kg. load and did 171.22 m.p.h. for 500 km. With a 1,000 kg. load he flew at 175.97 m.p.h. over 100 km., at 168.11 m.p.h. over 500 km., and at 152.7 m.p.h. over the 1,000 km. distance. Later, Shoenhair flew with a speed of 164.26 m.p.h. over a 1,000 km. course unloaded. Marcel Doret, of France, later went him one better with 179 m.p.h. for this distance—but these two marks have not received official homologation as yet.

In Europe the huge Italian Caproni 90 and German Junkers G-38 attracted much attention as did also the French Latecoere 28. Carrying ten metric tons (22,000 lb.), the Caproni flew 1 hr. 31 min. 39 sec. and to an altitude of 10,600 ft. This flight broke: (1) and (2) the record for duration and altitude for machines with a 7,500 kg. load, (3) also those for a 10,000 kg. load, (4) the mark for duration with 5,000 kg., and (5) the record for the greatest load carried to 2,000 meters.

The four-engined Junkers G-38 was taken into the air with five metric tons (11,000 lb.) and flown 100 km. at 114 m.p.h. The course of 500 km. was covered at an average speed of 108.6 m.p.h. Thus, at once, a distance record, with this load, of 310.6 mi. (500 km.) was set, an endurance record of 3 hr. 2 min., and a speed record. The Latecoere 28 seaplane, on the other hand, was credited with about a dozen marks for speeds and distances with loads, while an airline distance mark of 2,575 mi. went to Jean Mermoz for his flight across the South Atlantic in this machine. This plane is powered by a 600 hp. Hispano-Suiza engine.

The Brequet Question Mark also entered the news with an International record. In February, Coste and Codos set a closed-circuit duration record of 18 hr. 1 min., and a closed circuit distance of 2,060 mi. with the 1,000 kg. load using this plane.

Of greatest interest in the feminine flying field was the duel in Europe waged between Mlle. Lena Bernstein and Mlle. Maryse Bastie for the woman's solo endurance record. The former set a mark of more than 35 hr., but Mlle. Bastie finally turned in the winning count with an effort of 37 hr. 55 min. 43 sec. This, incidentally, approximates the world mark for solo endurance.

In America, better than 180 m.p.h. was made by Miss Earhart in a metal Lockheed Vega craft as a bid for the woman's maximum speed record. The news then told that Mrs. Florence Barnes had done better than 190 m.p.h. in a Travel Air Low-wing. Definite recognition has not yet been accorded the latter flight. Miss Earhart also flew the 100 km. course at 174.9 m.p.h. with 500 kg. load, ten miles below the male record set by Shoenhair.

THE $25,000 All-America Flying Derby, sponsored by American Cirrus Engines, proved to be the most interesting new competitive event of 1930. A race in every respect, with the only formula being elapsed time between control points, the Derby attracted eighteen entries, with ten finishing. Many of them were of interesting design; the rules required that Cirrus engines be employed, bringing several of the fliers to build special craft around that power-plant.

The 6,533-mi. tour of the country was won by Lee Gehlbach, who piloted a special low-wing Command-Aire; second went to Lowell Bayles, flying a Gee Bee Sportster; and third was taken by Charles Meyers in a Great Lakes Speedster. Gehlbach averaged 150 m.p.h.

Another innovation was the sadly-neglected Great Lakes Air Cruise. This was a 2,600-mi. overwater tour of cities dotting the five Great Lakes and Georgian Bay. An admirable idea to interest yachtsmen,—but only three craft entered!

Despite the growing pains of business depression, aviation's regular annual events, the National Air Races, National Air Tour, Elimination Balloon Race, and Gordon Bennett Balloon Race, were run off in good style.

The National Air Races were held at Chicago from Aug. 23 to Sept. 1, again with Clifford Henderson as managing director. The event was a financial success with 360,000 in attendance, but entries in the various commercial plane races and in a few of the derbies were rather disappointing as to number.

The races, which offered the spectator the usual mixture of military and commercial flying, were featured by

the participation of several leading foreign fliers. These men—Flight Lieut. Atcherly, England; Marcel Doret, France; Marshal P. Colombo, Italy; and Capt. Frederich Loose, Germany—put on shows highly lauded by the crowds. The aerobatics of Atcherly were especially noteworthy. As for the races, Benny Howard will be longest remembered for the striking way in which he captured the prize and that with his Wright Gipsy-powered Howard Special low-wing. He even placed third in the high speed Thompson Trophy race with his astonishing little craft. Charles "Speed" Holman, flying a special Wasp-Junior Laird at 202.02 m.p.h. average, captured that event.

Among the derbies, which attracted less attention than in the past, the non-stop event from the West Coast was won by Wiley Post flying a Wasp Lockheed Vega to Chicago in 9 hr. 21 min. 21 sec. Four of the five entries in this race flew Wasp Vegas, with the fifth flying a Hornet Lockheed Air Express.

With the National Air Races out of the way, the industry turned its attention to Detroit, where on Sept. 11 the sixth National Air Tour for the Edsel B. Ford Trophy got under way, the route taking the fliers north and west to the Southwestern Canadian provinces, then south through the Rocky Mountain and Southwestern states, and north again to Detroit. Eighteen competitors and a dozen non-competitors made the trip. The tour, some 4,800 mi. in length, ended Sept. 27 with Harry Russell, flying a 7-AT Ford with one Wasp and two Wrights, the winner, followed by J. H. Livingston and Art Davis, each in Wright-powered Wacos.

A new formula marked the event—a formula involving rated horse-power instead of piston displacement, reducing the part formerly played by stick and unstick, and using true top speed instead of pre-determined maximum speed as a factor.

Capt. Arthur H. Page, U. S. Marines, had won the eleventh Curtiss Marine Trophy Race at Anacostia, D. C., May 31, flying a D-12 F6C3 Curtiss Hawk. He averaged 164.08 m.p.h. to better the best previous mark of 162.02 m.p.h. established by W. G. Tomlinson in winning the race the year before. Capt. Page lost his life in an accident during the Thompson Trophy race three months later.

Among interesting aerial events of the year high place must be given to sundry sportsman-pilot air meets which give promise of more development along this line. Such meets were held at the Long Island Aviation Country Club and at Pal-Waukee Airport, Chicago.

Also, in a résumé of '30, we must not forget the great increase in state air tours. A check shows that seventeen different states were covered in such tours, and a goodly number of craft turned out for nearly every one. Arkansas and Iowa held their third tours, Nebraska, Michigan, and Indiana held their second, and Oklahoma and California were also repeating states. The others were: Pennsylvania, Minnesota, North Dakota, New York, Tennessee, Illinois, Colorado, Virginia, Wisconsin, and Missouri. There were also two comprehensive tours involving more than one state—the New England Tour and the Northwest Tour. The author does not doubt that there were still other tours which did not reach his news ear, so mushroom-like was the growth of these events in 1930.

WE will close our review with a word or two on European flights and European competitions. First to flights. Here we record that Wing-Comdr. Charles Kingsford-Smith now holds the England-Australia light plane record, for Oct. 9-19 he flew from the British Isles to Port Darwin, Australia, in 9 days, 23 hr. in a special Gipsy II Avian. This bettered the mark of Bert Hinkler, who in 1928 flew from England to Australia in a Cirrus Avian in 15½ days.

Another flight to Australia which proved feminine plane mastery was that of 23-yr.-old Amy Johnson. She flew solo from England May 5 and completed a 19½-day journey to Port Darwin. A few forced landings along the way slowed her trip.

Capt. Goulette, already credited with a Paris-Madagascar round trip, flew from the French capital to Teheran, Persia, a distance of 3,230 mi., Sept. 19-21. The flight made in a Lorraine powered Farman 192, required but 35 hr. With La Louette, he later (Nov. 8-13) flew from Paris to Saigon, French Indo-China, in 5 days, 3 hr. 50 min., bettering the time of Coste and Bellonte for this run by some 30 hr. But Coste still holds the Indo-China to France record of 4 days 50 min. The distance is approximately 7,500 mi.

Between April 9 and April 30, the Duchess of Bedford was piloted by Capt. C. D. Barnard from England to Capetown and return in a Fokker plane, and another long flight was the solo venture of Mrs. Victor Bruce in a Blackburn Bluebird from London to Japan. Moreover, a squadron of twelve Savoias is to be flown from Italy across the South Atlantic, with Air Minister Balbo in command—and that will surely gain a bright spotlight in flight news interest.

The Challenge de Tourisme Internationale, or light plane tour of Europe, was a leading competitive attraction. Again it was won by the German, Fritz Morzik, this time in an Argus AS 8 powered BFW M.23 monoplane. Baron Carberry piloted the only American plane entered, a Warner Monocoupe. He took sixth. Sixty planes from Germany, France, England, Spain, Poland, and Switzerland competed in the tour, which was run July 20-31 over a 4,660-mi. route.

A tour, too, was run in Italy covering the entire boot-shaped country. This affair was promoted by the Royal Italian Aero Club and an Italian publication because a dispute over last year's Challenge de Tourisme brought the Italian fliers to waive entry in the latter event. The tour of Italy was flown Aug. 25-31 with 52 starters, including a few from other countries. It was won by Colonel Sacchi in a 120 hp. Walter 15-S Breda machine.

Again feminine advancement was shown in England when on July 5 Winifred Spooner won the King's Cup Race for civilian aircraft. Miss Brown led 60 of the 88 starters to the tape in a Cirrus Avian with an average speed of 102 m.p.h. A. S. Butler, with an average of 129.7 m.p.h., was second, Miss Brown having beaten him with her 2½ hr. handicap. Flight Lieut. Waghorn, who was third, failed, however, to better Miss Brown's average.

In France, the Michelin Trophy went to Michel Detroyat when other fliers in the event failed to finish. He flew a 230 hp. Salmson Morane-Saulnier and averaged 124 m.p.h. This competition was a speed event over a 1,760-mi. course with fourteen compulsory stops enroute. Michelin Trophy rulings allow only planes with engines of 230 hp. or less to compete.

Finally we record thet Jugoslavia won the Little Entente and Poland Race, run through four countries Aug. 27-31. This nation flew against Czechoslovakia, Roumania, and Poland. Each had entered a team of six 2-place planes, Jugoslavia flying Breguets.

Transport and Engineering

OPERATIONS AND MAINTENANCE ON THE LUDINGTON LINE

THE organization of the Ludington Line to operate an airplane service every hour on the hour between New York, Philadelphia and Washington, where it is forced to compete with one of the best railroad services in the country in time between terminals, safety, reliability, comfort, and rates, over a route only 200 miles long, is without doubt one of the boldest recent developments in the entire field of transportation.

For success in such a venture two conditions are necessary, namely, unprecedented volume of traffic and the ability to operate at considerably lower unit costs than have come to be accepted on the majority of existing air-lines. The story of how they are achieving the first condition, will be told in an early issue of AVIATION. This article is devoted to their efforts toward the second.

The present schedule calls for a plane to leave the Washington Airport and a plane to leave the Pennsylvania Station in New York City hourly from 7:00 a.m. to 5:00 p.m. These eleven round trips with regular stops at Philadelphia, Baltimore, and occasionally Trenton, require about 4,400 miles of flying in about forty daily air hours, yet the entire fleet consists of eight Stinson tri-engined planes and one Stinson Junior, all powered with the 210 hp. Lycoming engine.

The selection of this equipment is the cornerstone of the line's economy program. The plane suited the needs as to general performance and size, and incorporated the necessary three-engined safety characteristics. Furthermore, its cost, in the neighborhood of $20,000, permitted a low capital investment and lightened tha burden of depreciation and carrying charges. Its comparative newness, backed up by a service guarantee from the manufacturer, was an actual advantage because it enabled the line to have many features and suggestions embodied in the design which especially adapted it to their particular requirements for rapid servicing, inspection, and overhaul.

The engines had the same features of low cost and desired performance and their ruggedness held promise of good maintenance characteristics.

The shortness of route makes possible many operating economies. No co-pilot is needed as the longest flight between airports is in the neighborhood of 50 minutes. For the same reason there is no necessity for a steward. The baggage is handled by a porter at the terminals, and the pilot collects tickets and performs the other small duties required by the passengers. The shortness of runs also allows the space usually occupied by toilet facilities to be devoted to baggage.

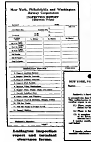
Communications and dispatching are likewise simplified. Teletypes are installed at each terminal and in the New York and Washington offices. The need for radio has not been seriously felt, although receiving equipment has been installed on all planes to receive the regular weather reports and to enable general entertainment broadcasts to be made available to the passengers through individual headsets. With personnel located at five airports on a 200-mile route and with planes traveling over the territory at such frequent intervals, the official weather reports are tremendously supplemented by direct observations and exchange of information.

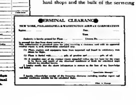
The allocation of aircraft to meet the scheduled departures is often complicated by cancelled trips due to weather and to the need for extra sections for especially heavy traffic or special trips. But in general, one stand-by plane and the planes leaving Washington at 4:00 and 5:00 p.m. are held overnight at Newark, and the rest are quartered for the night in Washington. The Stinson Junior has been used to great advantage when only partial loads are booked, or for overflow traffic.

The pilots, of whom there are thirteen, are scheduled for one round trip a day for five days with a one-day lay-off. Although the pilots on the line fly over 90 hours a month and are paid on a straight salary basis, they seem extraordinarily contended and thriving.

One of the important items of operating expense, that of fuel, has been cut to a minimum. Regular low test automobile gasoline is used throughout, except for warming up and starting, a small tank of high test automobile fuel being carried for this purpose. Whether this can be continued indefinitely remains to be seen. Meanwhile it is an extremely interesting experiment. Oil immersion heaters are used before the engines are started, which reduces the actual run-up time to four or five minutes; taxiing after landing is done on one engine when possible and other similar small wastages are avoided. The direct electrically driven Eclipse starters have also added materially in simplifying the handling of the planes on the ground. A few minutes of fuel or labor saved on each trip is an important item with such a small volume of operations.

The maintenance department also carries out this policy of efficient economy. The main base of the company is at the Washington Airport where an entire hangar is leased from its owners. Here are located the overhaul shops and the bulk of the servicing





Ludington inspection report and terminal clearance forms.

and repair work is done at this end of the line. Ten mechanics and fifteen helpers work here in two shifts, from seven to three, and from three to eleven.

At Newark, space for three tri-engined airplanes is leased in the municipal hangar and a force of three mechanics and two helpers carry out routine inspection and servicing. With the exceptions of arrangements for emergency calls upon the Ludington Flying Service in Philadelphia and similar arrangements in Baltimore and Trenton, there is no further maintenance personnel.

The company's belief in minimum capital tie-ups is again apparent. Spare flying equipment consists of but six complete engines, a complete line of engine spares at Washington, a supply of plane stores at the same field and a limited, yet complete, layout of parts at Newark. Much of the shop equipment has been built by the company's own mechanics. Benches, engine stands, ladders, working platforms, overhead derrick, have all been assembled from angle, tube, or sheet stock.

At Washington a small overhaul shop is equipped with engine lathe, drill press, arbor press, grinder, and of course special hand tools for the Lycoming engine. Here five men overhaul three engines a week.

At the end of each trip a thorough inspection is made, and the plane is serviced while it lies over for the next schedule. The form for this inspection is shown herewith. The ignition system, throttle and altitude controls, fuel system, valves, propellers, landing gear, control surfaces, and the battery are carefully checked. The plane is then cleaned and serviced. The engines are warmed, started, and run up. The mechanic who has been in charge of the work, signs the inspection and servicing record and the plane is ready for the pilot. If he is satisfied with it, he in turn signs a terminal clearance card. Both these cards are kept on file at tha two field operations offices.

Each night an even more complete inspection is made, all batteries are removed from the planes, checked over and charged, all planes are washed with water and soap flakes, and the cabins are thoroughly cleaned. Every 30 hours the oil is changed, every 40 hours the engine is given a thorough check; and every 300 hours the engines are removed from the planes and completely overhauled. The cowling and engine mounts have been so developed that an outboard engine can be removed and a newly overhauled engine substituted within an hour and a nose engine in about an hour and a half. The engine is put on a special working stand, the cylinders removed and a complete dissambly and reconditioning carried out. The routine of such an overhaul has been carefully standardized, the engine even moves around the small shop much as it would along the production line of a factory. The other members of the engine group are carefully gone over at this time. The magnetos and starters are tested and reconditioned, all propellers are checked as to track and pitch, and are balanced on a regular propeller stand. When the engines are remounted the compass on the plane is carefully swung and the other instruments thoroughly checked.

The Washington terminal is equipped to do its own metal working, and many cowling changes, tank modifications, etc., have been done in the line's own shop. Cabin heaters designed and patented by Luke Harris, maintenance manager, are also being built and installed there. Likewise, when shielded electrical equipment was needed for the radio installations it was built in Washington.

Both engine and plane have, of course, undergone modifications since the route was opened the first of September. The cowling and general engine installation of the planes has been somewhat modified to improve ease of access for inspection and overhaul. Some rather consistent fuel tank difficulties eventually required replacements by the manufacturer. The tail wheel yokes have been strengthened, and small changes in the positions of throttles, etc., made.

The engine has developed but one serious weakness, so far, in the form of some piston trouble. The change necessary was actually a removing of material from the underside of the pistons. Otherwise there has been an extremely gratifying low amount of replacements required when the engines have been overhauled. In two months of operating with the new equipment there was only one landing outside of a terminal due to mechanical difficulty and this landing was more of the "safety" than of the "forced" variety. In the same period there has been no scheduled trip delayed or cancelled because of the failure by maintenance department to have a plane ready, which in the light of the frequency of service and the small number of personnel and available planes, is truly a remarkable record.

CALCULATING MAXIMUM SPEED OF AIRPLANES

THE complete performance calculation for airplanes is a long and tedious process, and is usually unwarranted during the preliminary design stages, but empirical methods for estimating purposes have been found very useful. One of the best known and successful series of formulas for this purpose is that proposed by Edward P. Warner, editor of AVIATION, early in 1922. In the present article his maximum speed formula is discussed in the light of modern airplane performance.

A combination of reasonable assumptions and theoretical considerations indicated that a satisfactory approximation could be obtained from a formula of the form

$$V_{max} = K \left(\frac{P}{S}\right)^{n} \ldots \qquad (1)$$

where V_{max} is given in miles per hour when P is the available horsepower, and S the area of the supporting surfaces in square feet. Values for K, and n were determined by plotting the speeds of a number of existing airplanes on logarithmic paper, drawing a curve which most nearly fitted conditions, and calculating the equation of the curve. The plotting of the original data for some 65 airplanes, and the curve resulting, are shown in Fig. 1. The dotted lines represent a variation of plus or minus 10 per cent from the curve. It will be noted that the agreement of the data with the curve is remarkably close considering the diversity of types, which included land planes, flying boats, and seaplanes, all having varying degrees of thickness of wing, streamlining, etc.

The values for K and n derived from the curve are 127 and 0.39, respectively, giving the general expression of Equation 1 the form

$$V_{max} = 127 \left(\frac{P}{S}\right)^{0.39} \qquad (2.)$$

Theoretical considerations alone would indicate a value for n in the above formula of $\frac{1}{3}$. The slope of the curve, however, was determined largely by the maximum speeds of the machines in the relatively slow speed class. At the time the data was collected such machines were not given the careful attention to details accorded to airplanes intended for pursuit work. Where high speed was not the prime consideration, streamlining, fairing, and smoothness of finish and accessories were frequently neglected, all of which resulted in lowered aerodynamic efficiency. High top speeds are dependent upon clean aerodynamic design, and it is not unreasonable to expect that, as speeds are pushed higher, there will be a tendency to return toward the theoretical value of the exponent in the speed formula. That this trend is apparent today, at least in tha case of commercial designs, will be shown in subsequent paragraphs.

Since all the data on which the derivation of the above formula was based applied to airplanes designed and built prior to 1922, it was deemed desirable to make a similar study of present-day machines to see how they compared with the formula. Data have been collected on some 227 airplanes of various types, including representative machines of the Army and Navy, as well as the wide range of commercial airplanes. Of the total, 137 are service types, and the figures used have been taken from the

Army and Navy performance schedules issued during the early part of 1930. The balance, of 90 airplanes of commercial types, has been based on the figures given in the specification table published in AVIATION for November 1930. The service machines, therefore, include those designed and built up to the end of 1929 while the commercial airplanes have been brought up to date as of September 1930. In considering the data drawn from these two sources it must be borne in mind that the figures published by the Army and Navy represent accurate and careful testing under more or less standardized conditions, while the figures given by the manufacturers may be estimated performances, or the results of tests made under widely varying conditions. The results of this investigation are shown in Figs. 2 to 5, inclusive. In this series of figures the Army and Navy data have been separated from the commercial data, and the latter have been further sub-divided into three general classes of machine.

Maximum speed of the 137 service airplanes of all types has been plotted in Fig. 2. The lines on the chart are the same as shown in Fig. 1. A comparison with Fig. 1 brings out a number of significant points. In the first place, in spite of the wide variety of airplanes involved, and considering the advances in design during the intervening eight years, there is a remarkable adherence to the original curve. The average agreement is even better than in the case of the original data, as only 10, or about 7.3 per cent, of the total number of machines fall outside the 10 per cent limits. It will be noted that the points in Fig. 2 are much less scattered than in Fig. 1, and also that the entire group has moved upward along the curve, as would be expected. In Fig. 1 the top speeds vary between 65 and 160 m.p.h., a spread of some 95 m.p.h. between the slowest and fastest machines. The new data, however, indicates a spread from approximately 95 to 165 m.p.h., a difference of only 70 m.p.h.

Bearing in mind that both charts include data on widely different types, from high performance fighters and pursuit machine down through torpedo carriers, flying boats, amphibions, and training machines, the conclusions which may be drawn may be stated as follows:

(1) Not only is the maximum speed of all types increasing but the maximum speed of the slower types tend to improve at a relatively faster rate than that of the high performance types.

(2) The agreement of the most recent data with the maximum speed curve established in 1922 indicates that any change in slope or location of the curve is unwarranted, and that for purposes of approximation the relationship, expressed in Equation 2 still holds good. Progress in aerodynamic efficiency in military design, so far as high speed is concerned, appears to be nil.

In analyzing the commercial data the results were found to be much less consistent than those obtained for the Army and Navy machines. In order to avoid confusion and to prevent the blanketing of certain definite trends under a mass of unrelated data, it was considered expedient to break up the study of commercial data under three distinct classes of airplane.

Maximum speed data for multi-engine transport airplanes, amphibions, and flying boats have been super-imposed upon the curve of Fig. 1 in Fig. 3. As in the case of Fig. 2, the agreement between the points plotted and the curve is such that no change in Equation 2 is indicated. It is apparent that the original formula may still be safely used in estimating the top speed of airplanes of these classes.

A somewhat different situation exists in the case of Figs. 4 and 5 which represent respectively the maximum speed characteristics of single-engine cabin airplanes and single-engine open airplanes, including both monoplanes and biplanes. Assuming the consistency and accuracy of the data, it is obvious that there is a decided trend away from the original curve in both cases. Taking the points as they fell in Fig. 4, a number of trial curves were plotted of which the most consistent is the one shown as a dotted line in the figure. This curve has a slope of 1 to 3 on the logarithmic paper, which corresponds to the theoretical exponent. The equation corresponding to this line is as follows:

$$V_{max.} = 137 \left(\frac{P}{S}\right)^{\frac{1}{3}} \qquad (3)$$

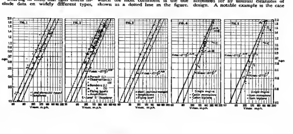
The points plotted for open cockpit monoplanes and biplanes in Fig. 5 yielded much less consistent results than those of Fig. 4. After a number of trials it seemed that the same modification of curve as was applied to Fig. 4 would also fit these conditions fairly well. This curve is shown as a dotted line in Fig. 5. In both Figs. 4 and 5 the solid line is the curve of Equation 2.

Aside from undue optimism on the part of certain manufacturers for their particular products, there is sound reason for the shifting of the original curve in the cases of commercial airplanes. Military requirements render impossible a cleanness of design which is readily obtained in commercial airplanes, as maximum aerodynamic efficiency must frequently be sacrificed for maximum military efficiency. It must be noted also that the data used in Fig. 4 to establish the modifying curve applies only to closed cabin airplanes. The original curve was based entirely on open cockpit machines of military type which included few, if any, monoplanes.

It would naturally be expected that a reasonably well-designed monoplane of the cabin type would be considerably cleaner aerodynamically, than even the best externally-braced military biplane.

In studying Figs. 4 and 5 special investigation was made of those points which showed a wide variation from the average curve, especially on the high speed side. In many cases it was concluded that the apparent high performance was due in no small degree to more or less exaggerated claims on the part of the manufacturer, as the designs obviously had no features of outstanding merit to warrant such performances. On the other hand, some of the variations could be very well accounted for by unusual cleanness of design. A notable example is the case of points A and B of Fig. 4. These represent very high performance cabin monoplanes, designed by the same manufacturer, in which every possible attention is given to smoothness in external finish, and where fairing is carried to the limit. Both are internally braced. The same applies to points C and D of the same figure, both of which represent machines with remarkably small projected area forward. Point A of Fig. 5 is a small single seater biplane designed primarily for military purposes, but placed on the market as a high performance sport machine. It will be noted that its performance falls almost exactly on the original curve which is based on military machines. The other outstanding variant in Fig. 5 are points B and C, both of which represent open cockpit monoplanes which have been given the utmost refinement in detail to reduce head resistance. The machine denoted by C has a retractable landing gear. Practically all of the other points on Fig. 5 which fall well to the right of both curves are for machines of very ordinary design in the moderate price class, and are offered to the public on a highly competitive basis. It is difficult to evaluate accurately the degree of enthusiasm which naturally creeps in under such conditions, so that it is necessary to view some of them with a reasonable degree of restraint. This condition could be materially improved if all airplanes from all manufacturers were tested under standard conditions by some disinterested central organization.

It may be concluded from the foregoing that the maximum speed formula stated above as Equation 2 derived by Mr. Warner in 1922 may be safely applied to present military airplanes, multi-engine commercial transports, and commercial amphibions and flying boats. For commercial types of open cockpit or closed cabin airplanes (both monoplanes and biplanes) the indications are that the modified form as given in Equation 3 will give somewhat more consistent results. It must be remembered in making use of these formulas, however, that they are based on averages, are for purposes of approximate estimation only, and that due allowance must always be made for any unusual features of the design under consideration.



MEASURING UNCONSUMED GASES IN EXHAUST

CATAPULTED into the public news by Captain Hawks' recent test flights between New York and Memphis, Tenn., the Moto-vita, a development from the laboratory of Dr. Miller Reese Hutchison, has been arousing intense interest in aeronautical circles.

A meter which measures the residual unconsumed gases in the exhaust of any internal combustion engine, thus giving a direct indication of the correctness of the carburetor setting, it holds great promise of eliminating a large amount of fuel wastage and of completely eradicating all dangers arising from the presence of poisonous carbon monoxide.

When gasoline is burned in the normal operation of an internal combustion engine, the products of the combustion appear in the exhaust as a mixture of gases. Approximately 80 per cent of this mixture is nitrogen, an inert gas. The relative proportions of the remaining constituents, principally carbon-monoxide and carbon-dioxide, tell a graphic story of how efficiently the engine is utilizing its fuel. When any fuel such as gasoline is burned, its carbon atoms are oxidized in two steps, first into carbon monoxide and then into carbon dioxide. Complete combustion, therefore corresponds to a complete elimination of carbon monoxide from the exhaust gases. Complete combustion means no fuel wastage and higher efficiencies.

To achieve such complete combustion, the proper amount of air must be mixed with the fuel. The following fragmentary table from the data compiled by the U. S. Bureau of Mines illustrates the effect of varying air-gasoline ratios on the exhaust gas components, carbon monoxide and dioxide, and also the corresponding relative fuel efficiency.

CO_2 Per Cent	CO Per Cent	Air-Fuel Ratio Lbs. Air-Lbs. Gas	Completeness of Combustion, Per Cent
6.0	11.8	9.0	52
6.5	11.4	9.0	55
7.0	10.5	10.2	58
7.5	9.6	10.6	60
10.0	8.2	12.2	74
10.5	5.4	12.5	77
11.0	5.0	12.8	80
11.5	4.2	13.2	82

It will be seen that if we can indicate continuously the percentage of carbon monoxide, or other products of incomplete combustion present in the exhaust gas, we will know just how efficiently the fuel is being consumed by the engine.

The Moto-vita is responsive to any combustible gas appearing in the exhaust (carbon monoxide, hydrogen, methane, or gasoline vapor). It indicates continuously the percentage of these gases (total combustibles) present in the exhaust at any time.

In order to establish the value of the indications in terms of per cent fuel wasted, a great many test runs have been made with the engine under test coupled directly to a dynamometer, and with the fuel consumed during the run carefully measured. Such tests have been made with varying loads and speeds and for each condition Moto-vita readings have been noted, as the air-gasoline ratio has been varied over the range possible without apparent loss of power or speed. With the amount of fuel used known, corresponding to each reading on the Moto-vita indicator for all conditions of load and speed, a scale has been established that shows directly the percentage of fuel wasted for all conditions of engine operations.

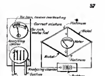


Diagram showing the electric principle of the Moto-vita.

Test installations of this instrument on airplanes, covering a period of nearly a year, have shown it to be a valuable aid to the economical and safe operation of all types of engines. Fuel savings of appreciable magnitude have been achieved.

The actual construction of the analyzer, is as simple as it is ingenious. The basic principle of its operation is that of the familiar Wheatstone electrical bridge. Of the four legs of the bridge, two are of platinum and two are of nickel, arranged as shown in the accompanying diagram, with the usual small battery and milliammeter. Since all four legs have the same resistance at equal temperatures, the battery current is evenly divided between the two sides of the bridge and no flow is recorded across the meter. Platinum heated over 300 deg. F. has one property, however, which is not shared by nickel, namely that of being a catalyst for oxidation. Therefore, when oxidizable gases are passed over the four wires of the system there will be a layer of oxidation taking place over the two platinum legs with no corresponding action over the two nickel ones. This oxidation producing heat, raises the temperature of the platinum wires and, of course, increases their electrical resistance, which unbalances the circuit and causes a current to flow through the meter as shown by the dotted arrows. Since the oxidation and the resultant current are proportional to the amount of oxidizable gas flowing over the wires, the reading of the meter can be calibrated in percentage of such gases for any given rate of flow. When applied to the gases of an engine exhaust, it gives a close approximate measure of the amount of carbon monoxide present, as that is the principal product of incomplete combustion. This can be further directly interpreted in terms of correctness of carburetor mixture.

Flying Equipment

THE JUNKERS "JUNIOR"

THE last twelve months have witnessed some gratifying results in metal-monocoque construction in this country. Several military planes have utilized such construction with considerable success, while its application to medium size and large cabin planes typified by the Towle and Thaden planes (described on pages 59 and 60), has been one of the truly remarkable features of the year. There is one field, however, in which the obvious advantages of such construction have been almost entirely overlooked by American designers—the two- and three-place sport plane. If there is any type of airplane structure which promises real production savings for large scale output, it is the metal monocoque, and if large scale production is ever realized it surely will be in the class of smaller planes. Why this obvious combination of facts has never been put together by the allegedly production-minded Americans is a difficult question. Possibly the mysteries associated with monocoque stress analysis has deterred the small manufacturer, but surely one of our larger corporations could have afforded such a development by this time, even if through the full static load test route.

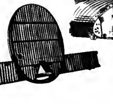
The Germans, as usual, have not overlooked the opportunity. For a number of months the Junkers "Junior" has been a common sight on European airports, the past summer saw one even on our own Roosevelt Field. Three were entered in the Challenge de Tourisme International in August and made excellent showings. There is nothing of an experimental flavor about it, it is an accomplished fact.

The Junkers Junior is indeed a smaller reproduction of all the Junkers features—low monoplane wing, corrugated sheet dural construction, simple lines, rugged appearance.

As in all Junkers planes the structure deserves detail study. In the wing structure of the Junior type two principal spars are built up of duralumin tubes and corrugated sheet webbing. These spars are given considerable structural assistance by the tube-like structure of the leading edge and a tube which is in line with the front of the aileron cutout. Light channels are rivetted to the upper and lower skin between and parallel to the spars as further reinforcement.

Simple diagonal strips maintain the spars in an upright position, while the drag-loads, as is usual in Junkers planes, are taken entirely by the metal skin.

A stub wing which carries the landing gear loads and makes the wing-folding feature possible, is similar in construction to the panels and is built integrally with the fuselage. The two main spars are carried through corresponding bulkheads. The front spar and bulkhead is illustrated. The four tubes of the main spars are provided with spherical couplings where they joint the stub wing, and the leading edge tube terminates in a double hinge which allows the wings to be folded up and back. When the panels are in flying position and the threaded couplings tightened up, the slot left open is covered over by a dural strip which is held in place by two springs.

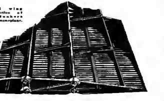


Photograph: The Armstrong-Siddeley Genet powered Junkers Junior. Above: Detail of the folding wing mechanism of the plane. Note that wing stub is integral with fuselage. Left: Front spar and bulkhead attachment showing general type of construction.

The fuselage itself is noteworthy on account of its multiplicity of stiffening rings in its structure. Some of these are simple tubes; some are flanged channels. The cockpits are reinforced with two cross bulkheads and horizontal strips running fore and aft. The entire engine-mount is easily removed and is separated from the fuselage proper by an aluminum fire wall.

The landing gear is of the split axle type and utilizes rubber cord shock units. Hydraulic brakes, individual for each wheel, are used as are the modern features of an adjustable stabilizer and push rod control for elevator and ailerons.

Three fuel tanks are provided, two in the wings and one, a gravity tank, just ahead of the forward cockpit. The latter tank of 2.7 gal. capacity is fed by a hand pump from the wing-tanks which are each of 7.7 gal. capacity.



General wing construction of the Junkers Junior-monoplane.

Equipped with an Armstrong Siddely Genet delivering 80 hp. at 2,200 r.p.m., the performance of the plane as certified by the German Government Aeronautical Experimental Institute is as follows:

Maximum speed at ground level	102 32 m.p.h.
Cruising speed	87 m.p.h.
Landing speed	48 8 m.p.h.
Range	378 mi.
Ceiling	18,880 ft.
Climb	3,280 ft. 5½ min.
Rate of climb	11.18 ft. per sec.
Span	33 8 ft.
Length	23.4 ft.
Wing Area	147 8 sq.ft.
Height	7.3 ft.
Tread	6.8 ft.
Weight empty	750 lb.
Gross weight	1,301 48 lb.
Wing loading	8.8 lb. per sq.ft.
Power loading	16.28 lb. per hp.

The Towle TA-3 amphibion powered with Diesel engines.

THE TOWLE AMPHIBION TA-3

ONE of the most interesting of the recent developments in all-metal construction has been the series of three all-metal, twin-engined amphibions culminating in the Towle TA-3. The first American all metal amphibion, using the Packard Diesel engine, and combining an extremely advanced and ingenious wing structure, with a competent, well designed hull, certainly deserves a place among the outstanding planes of the year.

One of the accompanying photographs illustrates the wing structure. The skin is of corrugated alclad. Spars, ribs, and drag bracing of the ordinary type are completely lacking. The internal structure consists of a corrugated alclad sheet zig-zagging from top to bottom of the wing section, and a system of stringers. Since the wing is full cantilever and continuous across the hull, these internal members extend from tip to tip. At each point of tangency between the webbing sheet and the upper or lower skin the corrugations of the webbing sheet have been flattened out. Alclad stringers are placed above and below these flattened places and all three are riveted to the skin in a single operation. The resulting wing is extremely strong in torsion and combines its rigidity with a good figure for weight per unit area.

The cabin of flat sheet alclad monocoque construction is arranged to comfortably seat six passengers and a crew of two. Entrance is made from land by means of a walkway up the afterdeck of the hull to a stairway hatch immediately abaft the wing. On the water, entrance can also be made by passing in through the pilot's compartment. The baggage compartment is located in the bow, the toilet facilities being to the rear of the cabin. The hull was designed to yield a maximum of seaworthiness. It is featured by a high bow, concave V bottom, water tight sponsons at the main step to add width, and a second step well aft, which reduces porpoising and shields the tail skid. The hull is

Wing structure of the Towle Amphibion

divided into five water tight compartments.

All the control surfaces are of corrugated sheets. There are three rudders and three fins. The main center fin is a built-in part of the hull and supports the entire tail group. All the movable surfaces are mounted on self-aligning ball-bearings and are controlled throughout by 5/32 in. flexible cable with the exception of the adjustable stabilizer which is worked through a torque tube.

Extra precautions have been taken to combat corrosion. All surfaces of the wing both inside and out have been coated with zinc chromate and aluminum pigment. All lap seams where water might collect are treated with asphalt paint. Full ventilation of wings and control surfaces is provided. In the hull each lapped seam has a tape, which has been treated in marine glue, placed between the sheets.

The landing gear retracts upward so as to clear the water, yet does not enter the hull or wing. The vertical struts telescope and are positively locked by a ¾-in. heat-treated steel pin which is visible at all times to the pilot. Controlled through steel cables the gear can be lifted or dropped in 20 seconds.

The plane is regularly equipped with two Packard Diesel 225 hp engines although either Wasp Juniors or Wright J-6 300s can be substituted. A 45 gal. fuel tank and an oil reservoir are mounted behind each engine in the nacelle. Eclipse electric inertia starters are used. The Diesel engine installation has proven quite successful during the months the plane has been under test, the non-inflammability feature has been generally appreciated and on cross country trips the fuel used was as obtainable as aviation grade gasoline.

Mr. & Mrs. H. V. Thaden and the T4 monoplane

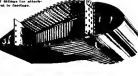
MODEL T4 THADEN

ADVANCED, ingenious, competent, engineering design has been incorporated into almost every feature of the 5-place all-metal cabin plane, the Thaden T4, which is manufactured by the Pittsburgh Metal Airplane Co.

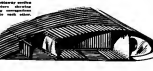
With the exception of the engine-mount, which is of chrome molybdenum tubing, the entire plane is of Alclad sheet and duralumin tubes and sections.

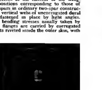
The wing structure is original and makes an interesting contrast with the types of construction adopted in the Junkers Junior and the Towle Amphibion. When one bears in mind the several quite dissimilar methods used by still other designers such as Northrup in his Alpha, by the Ford Motor Company in their tri-engined planes, and by Junkers in his larger machines, the infinite possibilities of all-metal design become extremely apparent. The external skin is of the usual corrugated sheet type from the trailing edge to what corresponds to the front spar; from this point forward smooth sheet stock is used. Formed by ordinary duralumin nose ribs, this leading edge is built in units and can be easily removed to allow inspection of the interior of the wing. In positions corresponding to those of the spars in ordinary two-spar construction, vertical webs of uncorrugated dural are fastened in place by light angles. The bending stresses usually taken by spar flanges are carried by corrugated sheets riveted inside the outer skin, with

Construction detail showing design of fittings for attachment to fuselage.



Looking down on cutaway section of wing structure showing method of placing corrugations at right angles to each other.





Photograph: Looking back through the fuselage structure of the Thaden T4. Sketch: detail of corrugated skin attachment to ring bulkheads

their corrugations at right angles to those of the skin sheets, and parallel to the span of the wing. These sheets are graduated downward in thickness, corrugation depth, and corrugation pitch, from the root of the wing to the tip. There are sheets of this type occupying the entire space between the vertical webs under the upper skin and two separate strips above the lower surface occupying about half that amount of the chord. The wing is further strengthened by a third vertical web member between the second one and the trailing edge. In addition to the nose ribs, there are a number of fore and aft members between the two main vertical webs, of the corrugated sheet and light angle type, spaced quite similarly to the compression tubes used in a fabric covered wooden wing. The wing is built in three sections, the two outer panels being attached to the center section through a large number of bolts which pass through eye-fittings fastened to the inner corrugations of the panel. These bolts are, of course, covered with a fairing plate, and permit a wing to be dismanteled in about twenty minutes. The weight of the wing structure is about 1.8 lb per sq.ft.

The fuselage to the rear of the engine mount is of corrugated monocoque construction of what might be called the ring bulkhead type. In the cabin these bulkheads or forming rings are made of T-sectioned extruded dural. To the rear of the cabin they are simply dural tubes formed to the required shape and spaced quite closely. The method of riveting these tubes to the skin is shown in the accompanying sketch, a large hole through which the header can pass, being drilled opposite the position of each rivet.

The engine mount is of steel tubing and is suspended on fittings at the fire wall through special rubber insulators which serve to materially reduce vibration. The cowling, which is of smooth sheet, is fastened entirely to the engine mount and can be easily removed.

The cabin is fitted with dual side-by-side, wheel controls, and has a seat for three across the rear, giving the common sedan arrangement. A rather novel feature provides a socket for the crank of the Eclipse inertia starter mounted on the dash board, enabling the engine to be started from inside the cabin.

The Frise type ailerons have a differential travel, upward 30 degrees, downward 10 degrees. The stabilizer is adjustable through a torque tube, the crank being mounted directly on the dash board.

The landing gear shock struts are of the Edgewater, combination oleo and ring-spring, type.

The manufacturer gives the following dimensions with the Wright J6 300 hp. engine:

Length overall	38 ft. 12 in.
Height	8 ft. 11 in.
Span	48 ft. 8 in.
Chord at root	87 in.
Chord at tip	52.5 in.
Wing area	274 sq.ft.
Weight empty	2,298 lb.
Gross weight	3,860 lb.

The D'Ascanio Helicopter showing lifting surfaces and trailing stabilizers.

THE D'ASCANIO HELICOPTER

DETAILS are now available concerning the helicopter, recently tested at the military airport of Ciampino near Rome. Designed by Corridino D'Ascanio and financially backed by Baron Pierro Trojani, it incorporates many excellent design features. Even more important, it has achieved a series of succesful flight tests unprecedented in helicopter development.

The lifting surfaces consist of two 2-bladed rotors, very similar in form to those of an autogyro, being of about the same plan form, section, and generel magnitude, and having the same feature of being free to rotate in a vertical plane, relying on centrifugal force to maintain an approximately horizontal position. The two rotors turn in opposite directions, the upper making about 75 r.p.m. and the lower about the same speed. Since they are connected through a differential devise, their torques are balanced out regardless of their separate speeds or angular settings. Each blade is fitted with a small, trailing stabilizer, controllable from the cockpit, and can itself be rotated about its longitudinal axis through the same set of controls. These rotors are driven by a 90 hp. Fiat air-cooled engine, though in case of engine failure they continue to rotate as an antogyro. The fuselage is of nickel steel tuned tobing, and is mounted on three wheels of the castor type. Landing loads are absorbed through ordinary rubber shock cord.

The system for stability and control are especially ingenious. On separate outriggers are mounted three adjustable pitch propellers, two in the horizontal plane and one in the vertical. Driven from the rotor shaft, these propellers are available for control even when the engine power is cut off and the large blades are operating as an autogyro. The controls are surprisingly simple. They consist of an ordinary control-stick and rudder bar, and one additional lever operating fore and aft. These are so connected that a forward or backward motion of the stick varies the pitch of the propeller furnishing longitudinal control so as to depress or raise the nose; a motion to the left or right, the pitch of the propeller for lateral control; and a movement of the rudder-bar that of the propeller mounted in a vertical plane and controling direction. The fore and aft lever controls the stabilizer setting and angle of incidence for all the blades together. Pulling it back results in an ascent, and pushing it forward, in a descent.

The machine has already completed the following flights subsequent to its initial tests inside an airship hangar:

A vertical climb from a 50 ft. circle to a height of 20 ft. remaining motionless over a fixed point for 1 min. and 31 sec.

A climb from the same circle and a flight in a closed circuit not less than 3,000 ft. in length and return to point of takeoff.

An ascent to an altitude of 59 ft.

A flight along a straight line of 1,836 ft., terminated only by the boundary of the field.

A duration flight of 8 min. and 45 sec.

APPROVED TYPE CERTIFICATES

DURING the period Oct. 4 to Nov. 29 the Aeronautics Branch of the Department of Commerce issued nine following Group I approved type certificates: 374 Fleet, 7 (Kinner 125 hp.); 375 Sikorsky, S39B (Wasp Jr. 300 hp.); 376 Fairchild, KR34D (Comet 165 hp.); 377 Laird, LCRW300 (Wasp Jr. 300 hp.); 378 Lockheed, Sirius DL2 (Wasp 420 hp.); 379 Swallow, HW (Wright 165 hp.); 380 American Eagle, Eaglet 230 (Szekely 30 hp.); 381 Northrup, Alpha 2 (Wasp 420 hp.); 382 Brunner-Winckle, Bird BW (Warum 110 hp.).

Servicing Short Cuts

FILTRATION OF ENGINE FUEL

SOME of the most consistently bothersome problems which have faced the airplane operator since the very beginning of controlled flight, have been those connected with loading engine fuel into the plane itself. Problems of

The G B filter funnel.

dirt and water content, problems of static electricity, and now of ever increasing importance, problems of rate of delivery. All these are tied up with the type of filtering, if any, used at the funnel through which the tank is being filled. The fuel companies have usually taken all possible precautions to deliver a clean and water free product; that they are unable to achieve 100 per cent success is due entirely to the sheer complexity and extent of the handling which the fuel must undergo between the refinery and the plane. Nor are the difficulties with the field tanks and pumps. A half dozen well developed types are in use; many of these deliver as much as 40 gal. per min. which seems sufficient for operating purposes.

The Standard Oil Company of New Jersey recently completed a series of tests on the comparative performance of several types of filtering. Chamois and felt filters, several types used by the military services, and a filter funnel developed by Gilbert and Parker of Springfield, Mass., were used. Measured amounts of water were introduced into the gasoline and compared with the amount retained by the filter. Rates of handling were also carefully recorded. The results should be of general interest to operators.

A good quality chamois collected from 90 to 100 per cent of the water but had a delivery rate of only 3 gal. per min. A poor grade of chamois passed 13 gal. per min. but held only 65 per cent of the water content. When the skins became dirty from continued use the delivery rates dropped to a third of their former values. Chamois has the further defect of offering the maximum static hazard unless the funnel is electrically contacted to the plane, and to the metal lining of tha fuel hose.

Felt filters were found to be even less satisfactory, under the best of conditions removing only 70 to 80 per cent of the impurities and having a discharge rate about comparable with thet of a poor grade chamois.

In general the cleanest bill of health was given a type of filter funnel using a combination of gravity and a 200 mesh strainer screen. It recovered 96 per cent of the water and impurities, delivered 26 gal. per min. under ordinary pressures, and, being entirely of metal, reduced the static danger to a minimum.

This filter which is illustrated in the accompanying photograph, relieves the pressure under which the fuel is delivered from the pump by passing it down from the top of the funnel through a ring of vertical baffle tubes. Once relieved of pressure, the action of gravity collects the water and impurities on the bottom of a lower compartment, and the fuel passes horizontally through a cylindrical screen, then downward and out through the delivery pipe.

AIRLINE MOTOR BOARD

AN especially well planned motor board for visually keeping track of the hours accumulated on each of their engines is being used by the Northwest Airways, Inc. It has served to insure the closest possible co-operation and efficiency between the operations, maintenance, and purchasing departments, in scheduling and providing for periodic overhauls.

The motor board, which is approximately 12x5 ft., is ruled into vertical and horizontal columns. For each engine there are three vertical divisions provided, while the horizontal divisions are entitled "Ready," 25, 50, 75, up to 300, followed by a double division marked "In Shop." For each engine a colored tag is provided, the color corresponding to the type, for example: Hornet, purple; Wasp, green; and Wright, yellow. On the lower half of this tag is written the name and number of the engine. For each plane in service, there is a white tag, half the length of the engine tag.

A section of the 'Motor Board' of the Aero Corporation of California

The first of the engine columns is provided with a hook opposite each horizontal division. When an engine has been newly overhauled or delivered from the factory, its tag is hung opposite "Ready." As soon as it is mounted in a plane it is moved to the hook in the next division above, and the tag for the plane in which it is installed is hung over it. In the second and third vertical columns are transcribed the dates and engines from the pilots reports. In this case, when the flying hours reach a total of 25 the engine and plane tags are moved up to the next division where they remain until 25 more hours accumulate, and so on. As the tags cross a red line at the 225 hour mark the various departments are automatically informed thet within 50 hours that particular engine will be due for overhaul.

A suggestion of our own which might be of use to some operators would be to make an entry on the reverse of the engine and plane tags each time the overhaul period is reached which would thus render easily available the often desired information of the total hours accumulated to date by that unit.

WASH-TUBS FOR ENGINE PARTS

SOME wash-tubs were needed by the Ludington Lines in the furnishing of a small lean-to, in which to clean engine parts during overhauls. Instead of sending to the nearest hardware store, an empty gasoline drum was pressed into service. A few minutes with a cutting torch and it was divided into two of the desired articles. One of them even has a removable screw plug which can be used to drain off the cleaning gasoline when it has become too dirty for further use.

Technical Abstracts

STRENGTH OF WELDED JOINTS

STRENGTH OF WELDED JOINTS IN TUBULAR MEMBERS FOR AIRCRAFT. *By H. L. Whittemore and W. C. Brueggeman, N.A.C.A. Technical Report No. 348.*

IT WAS the object of this investigation to make available to the aircraft industry authoritative information on the strength, weight, and cost of a number of types of welded joints.

The Bureau of Standards prepared a program from information supplied by manufacturers, calling for tests of 40 different joints, all to be made from chrome-molybdenum seamless steel tubing and sheet, conforming to U. S. Army specifications for that material. The joints are of three types: butt, "T," and lattice, the latter two being tested both with and without reinforcement. To insure that all the welding should be uniform and of good commercial quality the procedure recommended by the committee on welding procedure of the American Bureau of Welding was followed. These specifications covered the following subjects: material and apparatus, base-metal inspection, welding rod inspection, and qualification of welders. Welding wire conforming to American Welding Society specifications for gas welding rods G-No. 1A, was used.

For joints in chrome-molybdenum tubing ranging in size from ½ in. O. D. x 0.028 in. wall thickness to 2 in. O. D. x 0.065 in. wall thickness, the following conclusions apply:

1. The point of minimum strength and hardness of the base metal is sharply defined and is located about ½ in. from the weld center. Here the material may have strength ranging between 80,000 to 100,000 lb. per sq.in. in tension and 70,000 to 95,000 lb. per sq.in. in compresion and a Vickers number as low as 165.

2. For "T" joints loaded to high bending stresses near the joint it is probably more satisfactory to gain strength by increasing the size of tha tube rather than by adding plates, straps, etc. Where the joint is loaded in such a manner that bending stresses are kept to a low value, the efficiency may best be increased by welding a "U" strap around the joint, the ends extending at least 1 in. below the joint. The efficiency of an unreinforced joint was found to range from 55 to 77 per cent. Reinforcement by means of "U" straps increase the efficiency to 87 per cent. Strap-reinforced joints in which a tube is encircled by a circumferential weld are, however, subject to a reduction in the tensile strength of this tube. An unreinforced "T" joint in 1½ in. x 0.058 tubing requires about eight minutes to fabricate and the weld metal weighs about 0.02 lb. The strap joint requires 28 min. to fabricate, and the weight of the weld metal and reinforcement is 0.16 lb. These values are increased to 46 min. and 0.56 lb. for a joint having equal strength reinforced by corner gussets.

3. The best reinforcement for the lattice joint is one which reinforces it against collapse of the tubes. This reinforcement may be either an inserted plate or a strap welded around the joint. Both methods increase the strength of the unreinforced joint about 20 per cent. When gusset platea are used for reinforcement a decided gain in strength is obtained by inserting one plate in all tubes rather than welding several plates in the angles between the tubes.

4. Cracking is an important problem when gusset plates are used for reinforcement. The procedure to be used in welding each type of joint should be developed experimentally and the design discarded if it can not be welded consistently without cracking.

5. The use of four representative oxyacetylene torches indicated that no difference in the joint strength could be attributed to the torch.

6. Low-carbon rod apparently gives enough strength in the weld to cause the specimen to fail in the base metal for the majority of joints.

PRESSURE AND ROLLING DATA

PRESSURE DISTRIBUTION OVER A YAWED AIRFOIL. *By D. H. Williams, With an Appendix on* ROLLING MOMENTS ON A YAWED AIRFOIL, *By A. S. Batson, British Aeronautical Research Committee R. & M. No. 1203.*

PREVIOUS measurements of pressure distribution over an airfoil have been made with the airfoil at 0° yaw. This investigation, made at the National Physical Laboratory, was undertaken to determine how the pressures varied when the airfoil was yawed to a considerable angle.

The airfoil was of R.A.F. 15 section, aspect ratio 6, chord 4 inches, with square wing tips. Measurements of pressure were made at seven sections along the span, six in the right semispan and one in the left. At each section the pressures were determined at eight points on the upper surfaea and seven on the lower. Measurements were made at all points at angles of incidence ranging from 0° to 40° by 4° steps, and at every 5° of yaw from —30° to +30°.

The actual observations were not included in the report because they applied only to the particular airfoil and the object of the investigation was to study the type of distribution of pressure and the variation with yaw as applied to all airfoils in general. The results were all presented in the form of charts.

Below the stall, the distribution varied little with yaw except at the wing tips. The resultant normal pressure was very high at the leading edge and fell rapidly to nearly zero at the trailing edge. At the wing tips there was a region of high negative pressure at 0° yaw, the suction on the leading tip increasing in magnitude as the angle of yaw increased, while that at the other tip tended to vanish. Thus, below the stall, the rolling moment was due almost entirely to the negative pressure on the upper surface at the leading wing tip, and the value of this moment was small.

Above the stall, the type of distribution was very different. At 0° yaw the central part of the wing stalled first, the stalled area spreading as the incidence was increased until the whole wing was stalled at about 24°. When the airfoil was yawed the leading half of the wing tended to become unstalled while the entire area of the trailing half remained stelled (at 24°, a small area of high negative pressure still existed at the forward edge of the trailing wing tip at 16°, but had disappeared at 20°.) With the wing stalled and yawed a large rolling moment was obtained. This was due in part to the large unstalled area in the leading half of the wing, and in part to the piling up of pressure at the leading wing tip. At about 30° incidence and 30° yaw, the suction at the leading tip reached a value of over—2.5pVs.

As a check of the rolling moments as obtained from the pressure measurements by integration, the rolling moments were measured, using the same airfoil at the same angles of incidence and yaw. The agreement between results was found to be reasonably close, especially below the stall.

WATER PRESSURE ON HULLS

WATER PRESSURE DISTRIBUTION ON A FLYING BOAT HULL, *By F. L. Thompson, N.A.C.A. Technical Report No. 346.*

THIS report is the third devoted to investigations of water pressures on seaplane floats and hulls.

Tests were conducted using a twin-engined Curtiss H-16 flying boat weighing 10,500 lb. loaded, and with a landing speed of about 50 m.p.h. The hull was a wooden structure of rather con-

ventional lines with a 21° V bottom, sponsons, and two steps. Water pressures at 15 stations in the hull bottom were measured simultaneously during landings and take-offs under various conditions of rough and smooth weter. Accelerations along the three reference axes of the seaplane were also measured.

The greatest pressures were found to be about 15 lb. per sq.in., occurring near the keel at the main step during landings. Rough water takeoffs gave pressures up to 11 lb. per sq.in. at the keel slightly forward of the middle of the forebody, and large total loads over this area were recorded. The greatest pressures were borne by an area which was roughly a triangle with its base at the step and its apex on the keel at the load water line forward. The maximum pressures on this triangle decreased in magnitude toward the bow and chines. An almost uniform maximum of 8 lb. per sq.in. was measured over the whole bottom between the steps during landings.

The maximum accelerations measured were, vertical, 4.7g; horizontal, 0.9g; and lateral, 0.5g.

Comparison of these results with those of the investigation of single and twin-floats shows a magnitude of maximum pressure approximately twice as great on the H-16 as on the UO-1 (single float), and 50 per cent greater than the maximum on the TS-1 (twin float). This difference was due, partly to the greater angle of inclination of the forebody of the boat hull, but more directly to the fact that the comparatively low lift to drag ratio of the H-16 boat gave it a greater rate of vertical descent than the seaplanes, maximum pressures being proportional to the square of the vertical velocity.

Side Slips

BY ROBERT R. OSBORN

AN AVERAGE DAY AT THE WHOOSIS AIRPLANE COMPANY

Work at the airplane plant, as imagined by the board of directors of the Whoosis Airplane Company.

Chief Engineer—I'm not going to be in tomorrow or the next day. I've got tickets for the game so might as well take the week-end off.

Sales Manager—Don't tell your sad tale to me. I won't be in either. I'm going on a four-day duck shoot along the coast. Why bother telling anybody, nobody'll notice you're not here.

Factory Manager—I've ordered some upholstered stools for the draftsmen, they're complaining the old ones were not very comfortable.

Chief Draftsman—Better order them lower too. Joe Smith darned near got a fractured skull falling off one of the high ones when he was asleep yesterday.

Chief Designer—There seems to be some hollering from the Old Man lately that wa ought to get out a new design. Do you think it would be easier to change the motor mount on the mail plane or should I get Joe to weld up a new rudder shape for the trainer?

Chief Engineer—You changed the rudder the last time, so you'd better not try that again. A new motor mount is a lot of trouble, though, so why not work up a new tail skid for the amphibion?

Chief Designer—O.K. I'll tell the shop to weld one up and we'll put a couple of detailers on it when they get it done.

Purchasing Agent—The bid on the rugs for the offices was $600 each and the interior decorating will be $800 per office. That sounds about right, doesn't it? Who remembers what the price was when we had it done four months ago?

Sales Manager—That sounds good to me. Maybe they could do it over the week-end while we're awey if we pay them a bonus.

Shop Foreman—(Interrupting) Pardon me, Gents, but I've got a ship nearly done in the shop and I ought to have a motor for it, or should I make a glider out of it?

Chief Engineer—What sort of a ship is it?

Shop Foreman—Dunno. The mechanic who told me about it said it was a biplane or something.

Chief Engineer—Well, look over behind that barrel of priming paint in the stock room. Thought I saw a motor there last week, but it might have been a drill press or something like that.

Shop Foreman—O.K. If there's nothing there we'll sell it less motor and make the customer put his own engine in. While I'm up here, tell me—is there any Yale money around for the game and what are the odds?

Chief Engineer—Well, well. Just the man I was looking for. Let's send out for all of the morning papers and then all go in my office and get some bets lined up. I've got to make my expenses to the game in some way. My traveling account has been pushed a little hard lately, and the head office is complaining about it a bit.

■

Minutes of the directors' meeting as imagined by the employees of the Whoosis Airplane Company

Chairman of the Board—Now before we go on with other business, gentlemen, is there any more Harvard money loose around here? I'm betting on two touchdowns.

First Director—No, you've covered everybody who doesn't get time to read the sporting pages. Let's get going. I've got a conference with my golf instructor at three o'clock.

Second Director—I read in the papers this morning we had developed a new type of landing gear. What's a landing gear anyway? Is it used on an airplane or something?

Third Director—I don't know what it is, do you, Bill?

Another Director—No, but if you really must know, ask my secretary on the wey out. She went out to a flying field once, and her kid brother is learning to fly somewhere.

Second Director—What do you think about firing some of our engineers this afternoon? I was talking to one of them the other day and he claimed wa are making the air line carry such heavy loads in the ships they aren't safe any more. If they can't co-operate with the air line by designing ships that will carry the loads I think we should fire some of them as a warning.

Third Director—Good idea. Maybe we could trade the whole outfit to Chicago for two good pitchers and a second baseman. If we end up another season at the bottom of the league we might as well sell the ball park for a miniatere golf course.

Chairman—Sam, you're getting mixed a bit. This is a meeting of the Amalgamated Fruit Growers Association.

First Director—Say, isn't this the meeting of the Whoosis Airplane Company?

Chairman—Yeah, that's right. I was confused myself.

Second Director—Well, what about firing those engineers or shall we just reduce their salaries?

Another Director—What engineers?

Second Director—Oh, well, I suggest we cut out wasting time this wey. We've got to stay in here long enough for the reporters to think it has been a good meeting. Let's continue to pass all dividends, issue a report that prosperity is just around the corner and that our confidence in the future of aviation is being justified. We might as well have a few hands of Red Dog; let's cut for deal.

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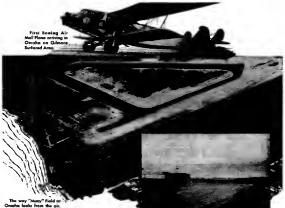

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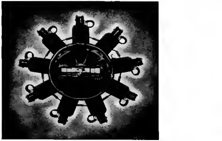

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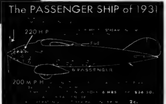

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Room 1-C, Airport, Oakland, California
Gentlemen: I am interested in

- ☐ Private Pilot
- ☐ Limited Commercial Pilot
- ☐ Transport Pilot
- ☐ Boeing Master Pilot
- ☐ Boeing Master Mechanic

Name ______________________

Address ______________________

City ______________ State ________

The Answer To The SMALL ENGINE QUESTION

Very shortly, The Kimball Aircraft Corporation will announce a new engine for light planes—the result of elaborate research and experimentation.

Write for advance information

THE KIMBALL AIRCRAFT CORP.
NAUGATUCK, CONN.

Boeing Flying Boats . . . now only $15,000!

The six place Wasp-powered Boeing Flying Boat is the one flying boat on the market which perfectly combines the seaworthy qualities of water craft with airplane performance. It is the fastest single-engined flying boat built.

Coupled with the new low price is improved performance. Speed increased 15 m. p. h.; climb increased 250 f. p. m.; takeoff reduced 8 seconds. When taxiing, turns are made with equal ease in either direction. Taxis safely at 50 m. p. h. Sturdy hull construction. Remarkably airworthy and economical to operate. Roomy, glass-enclosed cabin. Write or wire for detailed data.

At the new low price of $15,000 this flying boat offers real opportunities for operators sportsmen and flying clubs. Price—F.A.F Seattle.

BOEING
AIRPLANE COMPANY
SEATTLE, WASH.

A Division of United Aircraft and Transport Corporation

PERFORMANCE
(With full load)

PAY LOAD 5 passengers—913 pounds.
HIGH SPEED. 133 m. p. h. Cruises 105 m. p. h. Cruising range, 400 miles. Takeoff, 750 feet.
SPECIAL FEATURES Noiseproofed and insulated cabin, comfortable leather-upholstered seats, separate compartments for baggage and anchor gear, electric inertia starter, navigating lights elevating windows and windshield non-shatterable glass, complete instrument board equipment No extras to buy.

RELIANCE TACHOMETERS

ACCURACY
IS THE BACKBONE OF RELIANCE TESTING

Outstanding in the field, RELIANCE Tachometers are found on the test stands of the foremost engine manufacturers throughout the industry. The most exacting—the most severe engine tests have proved RELIANCE TACHOMETERS to be the most durable instruments for the purpose.

Each RELIANCE Instrument is so carefully engineered that when assembled the complete instrument is a custom job ready to give unfailing service for years to come.

"YOU CAN RELY ON RELIANCE."

Catalog of Standard Tachometers and Fittings will be sent gladly on request.

BARBOUR STOCKWELL COMPANY
CAMBRIDGE, MASSACHUSETTS

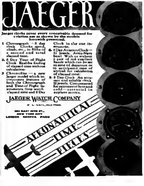
RAYMOND MANUFACTURING CO.
CORRY, PENNSYLVANIA

JAEGER

Jaeger clocks cover every conceivable demand for aviation use as shown by the models herewith presented.

1. Chronograph — 8 day clock. Checks speed, climb, etc., in fifths of a second and total elapsed time.
2. 8 Day Time of Flight Clock. Enables finding of elapsed time without calculation.
3. Chronoflite — a new Jaeger model which incorporates features of both the Chronograph and Time-of-Flight instruments. Stop watch elapsed time and 8 Day Clock in the one instrument.
4. 8 Day Aviation Clock—11 jewels. Army-Navy bezel. With or without a pair of red auxiliary hands which can be set to time of departure or to anticipated time of arrival for calculation of elapsed time.
5. 8 Day Clock. An accurate and reliable clock 11 jewels. Compensated for extremes of heat and cold—essential in airplane service.

JAEGER WATCH COMPANY
E. L. VAIL, VICE-PRES.
304 EAST 45TH ST.,
NEW YORK CITY
LONDON GENEVA PARIS



FAMOUS FLIGHTS WITH THOMPSON VALVES

'Round the World

IN THE RECORD-BREAKING

"CITY OF NEW YORK"

(This advertisement is one of a series recalling historic airplane flights in which Thompson Valves were used.)

For the first time in history, the world was circled in the incredibly short period of 23 days and 15 hours when John H. Mears and Captain C. B. D. Collyer made their famous trip in 1928.

Leaving New York City with their plane "City of New York" aboard steamship, they sailed to Cherbourg, flew eastward overland by plane, crossed the Pacific by boat and returned from Seattle to New York by air. On July 22d, they completed the speediest trip 'round the globe ever made.

\+ \+ \+

Only the perfect flying performance of the "City of New York" made possible this new world's record. The 18 Thompson Valves in the Pratt-Whitney "Wasp" motor of this famous plane contributed much toward unfailing engine operation.

It is such unvarying reliability in nearly every outstanding American flight since 1925 that has influenced the adoption of Thompson Valves for today's finest American airplane engines.

THOMPSON PRODUCTS, INCORPORATED
General Offices: Cleveland, Ohio, U. S. A.
Factories: CLEVELAND and DETROIT

Thompson Valves

Guarding the

Aviation Industry

with copper-steel

Better materials! Better construction! These are the watch-words of the aviation industry. And this idea should begin at the property line — with Cyclone Fence. Made of copper-steel, designed for strength and durability, it brings you the finest in materials and construction your fence dollar can buy. Cyclone Fence is the standard protection for airplane factories and airports throughout America.

Cyclone Fence

Cyclone Engineers help you plan your fence. Trained men erect it. Prompt service everywhere. Phone, wire, or write for information.

CYCLONE FENCE COMPANY
General Offices, Waukegan, Ill.
Branch Offices in All Principal Cities

Pacific Coast Division:
STANDARD FENCE COMPANY, Oakland Calif.

SUBSIDIARY OF
UNITED STATES STEEL CORPORATION

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If it's
DEPENDABILITY
you want...

... to keep your Production Lines on the move, Barnes-made Springs have been building a reputation for dependable service for years. Won't you tell us your spring requirements ... one or a million?

The Wallace Barnes Co.
BRISTOL, CONN., U. S. A.

Sitka Spruce

Clear selected grain and inspected to U. S. Aircraft specifications. Spars, beams and rib stock—all sizes—all lengths. Immediate shipments, express or freight same day.

PLYWOOD

Mahogany, 1/40" — Cedar 1/32" — Birch, 1/24"
Spruce, 3/64" — Bass, etc. 1/16"

GLIDER—VERITHIN—CO-VE-CO
1/40 in., 3 ply. Wt. 2½ lbs. per 100 Sq. Ft.

Balsa	Birch	Ash	Walnut	Poplar
Mahogany	Hickory	Bass	Cedar	Maple

Write For Catalog and Price List

Yoho & Hooker Lumber Co.
LARGEST ASSORTMENT OF AIRCRAFT WOODS IN THE WORLD
240 Wing Bldg., Youngstown, Ohio

HOLLEY CARBURETORS

EASY STARTING *and* POSITIVE "PICK-UP"

We manufacture a complete line of carburetors for airplane engines from 60 h.p. to 600 h.p. Several of our models are shown below.

Descriptive literature, yours for the asking, gives full details of design, construction, control and adjustment. Write today.

HOLLEY CARBURETOR COMPANY, DETROIT, MICHIGAN
Carburetor Specialists Since 1903

Duplex 2½" — Duplex 2½" — 2½" — 2" — 1½" — 2"

COLONIAL GRAIN AVIATION LEATHER

It is everything upholstery should be!

Colonial Grain Airplane Leather is far more durable than cloth and looks attractive much longer. It can be washed with soap and water at any time, and thus kept clean.

It is fireproof and light in weight. Furnished in a wide range of colors and effects.

Operators of transport lines should write at once for samples.

EAGLE OTTAWA

EAGLE-OTTAWA LEATHER CO.
GRAND HAVEN, MICH.
Sales Offices: NEW YORK — CHICAGO — ST. LOUIS — SAN FRANCISCO

Aircraft Service Directory

Professional Services

Good Advice

Should Be Solicited When Needed

Every Airplane Plant presents a set of highly individual problems that must be answered by expert assistance, taking into consideration all of the technical peculiarities of the plant under scrutiny.

You can find the specific answer to your aviation problem through the Directory of Professional Service shown on this page.

Where to Fly

Searchlight Section

(Continued on following page)

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or SPECIAL

UNDISPLAYED—RATE PER WORD

Positions Wanted, 10 cents a word, minimum $2.00 an insertion, payable in advance.
Positions Vacant, and all other classifications, including equipment, 10 cents a word, minimum charge $3.00 an insertion.
Proposals, 50 cents a line an insertion.

INFORMATION:

Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.
Discount of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH

1 inch $6.00
2 inches .... 5.75 an inch
4 inches .... 5.50 an inch
Other spaces and contract rates on request
An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL THE 15th FOR ISSUE OF FOLLOWING MONTH — Aviation

FOR SALE

(Continued from preceding page)

1 LINCOLN Sport in good condition and engine, propeller and wheels, $150. 1 set Thomas Morse boxes wings, excellent condition $40. Two 150 hp. Hissos, and magneto, carburetor, etc., suitable for Aero School $40. Material located Albemarle, N. J. Laurence Reynolds.

RYAN Brougham J-5 in wonderful shape. Flown very little, always kept in hangar. Brakes, full set of instruments. A real buy. F-541, Aviation, 520 No. Michigan Ave., Chicago, Ill.

TRAVEL AIR 6-pass. cabin plane, 193 hours, Wright J-6 300 hp. motor. Fully equipped and many accessories. Perfect shape throughout having had own licensed mechanic. Low price. Box 1898, New Haven, Conn.

USED Velie M-5 motor for sale $350, terms $100. George Howell, 1230 Drexel, Detroit, Michigan.

VOUGHT seaplane overhauled with pontoons and landing gear, metal propeller and two overhauled motors. Price $3,200. New Orleans Airline, New Orleans, La.

WIRE wheels, brand new, heavy spokes 26x4 cylinder $8.50, 30x5 $8, $12. J-5 cylinders, cannot be told from new, standard bore $50 with valves, Cirrus Mark III heads, with new valves and rockers $50. New 4 cylinder Scintilla $75. Complete and replacement parts for all motors—also spars, ribs, wing and fuselage covers, grade A cloth at very low prices, send us your inquiries. Air Transport Equipment, Inc., Garden City, N. Y.

PARACHUTES, approved types, seat, back, chest and trainers bought, sold, exchanged, repaired. Professional jumpers and balloonists furnished everywhere. Est. 1903. Thompson Bros., Balloon & Parachute Co., Aurora, Ill.

REPAIRS

HAVE your ship put in A-1 shape. Recovering and refinishing specialty. Also motors overhauled. Rates reasonable. Rainbow Flying Service, 701 Delaware Ave., Albany, N. Y.

TRADE

WILL trade Waco 10 for T. P. Trainer. Will trade OX-5 Robin on Challenger Robin or Stinson. Burlington Flying Service, Burlington, Iowa.

EQUIPMENT WANTED

100 AIRPLANES and engines wanted for my customers. What have you? Write at once. Karl Ort, York, Pa.

Exchange for light two or three place plane, must be licensed, a perfect one karat blue white diamond and a fourteen foot Century out-board boat, will seat four, powered with a 1930 two-cylinder Model 30 racing Caille with dual carburetors.

E-38 Aviation
Tenth Ave. at 36th St., New York City

AIRPLANES REBUILT
NO LABOR CHARGE

We will rebuild any ship in our fully equipped shops. You pay for material used. All work supervised by licensed mechanics and inspected by Dept. of Commerce. Phone [illegible], or write *Aviation Division*.

STEWART TECHNICAL TRADE SCHOOL
[illegible] West 64th St., New York City

EQUIPMENT WANTED

WANTED—Price for motor cowling or ring and pants for wheels for J-5 Waco Taper wing. Otto Wolf & Son, 468 Broad St., Bloomfield, N. J. Phone Bld. 2-0006.

WANTED OX-5 Travel Air fuselage, tanks, cowlings and center section struts. Roger Mensing, 1218 Jones St., Ft. Wayne, Indiana.

WANTED new Fleet, Bird or Moth at bargain cash price. State bottom price in first letter. L. F. Sharpless, Whitehall, Haverford, Pa.

WANTED new Whirlwind Standard D-25 or Whirlwind Waco or Lycoming Stinson. State lowest terms. EW-44, Aviation, 520 No. Michigan Ave., Chicago, Ill.

WANTED, complete set pontoons suitable for ship gross weight 3,500. Give price and description first letter. Also good used or damaged airplanes and engines. P. O. 1024, Tampa, Fla.

WILL buy—plane with radial engine both needing overhaul. Must be cheap, modern, licensed, and never crashed. Cleveland Institute of Aviation, Inc., Municipal Airport, Cleveland, Ohio.

POSITIONS WANTED

LIMITED commercial pilot, 130 hours, age 31, married. B. S. in mechanical engineering. Expert draftsman. Seven years business experience. Prefer engineering or flying, but will consider connection of any kind in aviation. Good references. H. M. Eldred, 36 Blake Street, Springfield, Mass.

TRANSPORT pilot, 15 years as instructor and cross-country pilot, clean record, no cracks. Excellent all around licensed A & E mechanic. Experience as field manager, shop foreman, or service manager. Will accept any reasonable proposition. Sober and hard worker. PW-47, Aviation, Tenth Ave. at 36th St., New York.

AVIATION EXECUTIVE

Fourteen years' apprenticeship in flying, maintaining and operating many types of land planes and seaplanes. Wide experience in all aspects of commercial aviation extending over four continents. Fully realizing the present need for efficient and economical management, his business capabilities combined with his technical knowledge fit him for the general operating traffic or sales management of a soundly conceived enterprise.

PW-39, Aviation
339 Chamber of Commerce Bldg.
Los Angeles, Calif.

Wanted

WANTED

Best price paid for new production air cooled crank-cases and parts. Ships also repaired and refinished according to Dept. of Commerce specifications. Low rates.

R. A. WHITLOCK
Box 144, Middletown, N. Y.

POSITIONS WANTED

PILOT SECRETARY—Licensed transport pilot, with business and newspaper experience, desires to serve busy traveling executive. Conservative, resourceful pilot. Can take fast stenographic dictation, typewrite and andwe publicity work. University graduate, age 29, single. PW-42, Aviation, Tenth Ave. at 36th St., New York.

TRANSPORT pilot, experienced cross-country passenger and instruction work, 800 hours open and cabin ships, finest references, age twenty-five. PW-20, Aviation, Tenth Ave. at 36th St., New York.

POSITIONS VACANT

WANTED experienced aeronautical engineer with some executive ability, must be progressive—adaptable, by established company engaged in latest aviation development. Excellent opportunity. Location near New York. P-45, Aviation, Tenth Ave. at 36th Street, New York.

BUSINESS OPPORTUNITIES

CORPORATE, organizing and promoting of meritorious enterprises, reorganizations, mergers and new financing. The Brookworth Company, Inc., 116 East 42nd St., New York City.

Half-Interest in Licensed Waco 10
With free instruction, $420. Congenial partner. Long Island Aero, Roosevelt Field, L. I.

MISCELLANEOUS

For Sale
Comprehensive private file of expert in engineering and servicing. Basis of well-known book on aircraft servicing and rigging. FS-43, Aviation, Tenth Ave. at 36th St., New York.

FOR SALE
New Light Airplane Project

Available to reliable party. Complete design and production data on an outstanding development by design engineer of America's foremost Two-Seat, Department of Commerce Approved, Light Plane.

D. R. WEBBER
6022 Wyandotte St., Kansas City, Mo.

FOR SALE

Tachometers, new and guaranteed, Johns Manville ratio 1 to 1 or Van Sicklen ratio 2 to 1, $9.95, new instruments, $1.10, new air speed and Venturi $9.95, new non-shatterable goggles, $1.75, oil pressure gauges $2.10, Heywood starters, $15.95, new Liberty cylinder assemblies, $40, new and complete LeRhone engines, $60, and compasses G.R. type, $16.95. Write for complete list.

Cie. Internationale Aeronautique
6003 Roland Ave., Baltimore, Md.

THREE GEE BEE SIDE BY SIDE BIPLANES

Demonstrators, 75 to 200 Hours. Prices $2000, $2500 and $3000. These ships like new. Factory guaranteed.

GRANVILLE BROS. AIRCRAFT, INC.,
Springfield Airport
Springfield, Mass.

FOR SALE
New Aircraft Materials at Attractive Prices

Mahogany Plywood (all sizes). Spruce Lumber. Steel Tubing, Round and Streamline, both 1020 and 4130. Bolts, Sheet Steel and All Kinds of Hardware.

SEND FOR QUOTATIONS AND PRICE-LISTS.

Kreider-Reisner Aircraft Co., Inc., Hagerstown, Md.

Airplane Engines — *For Sale*

10—Curtiss OX5's. 5—Curtiss OXX6's.
10—Hisso Model "A"'s. 5—Hisso Model "E"'s.
Rebuilt, Block Tested and Run In. Send for Description and Prices.
Curtiss OX5 and Hisso Parts.
Authorized Kinner Parts and Service.

BECKMAN MACHINE WORKS, INC.
6000 W. Lake St., Chicago, Illinois

FOR SALE
TRAVEL AIR

4D 3-place open cockpit, Wright J-6 seven Engine, 300 hp. De Luxe equipment, landing lights, flare brackets, electric starter, etc. Total time 325 hours.

BELLANCA AIRCRAFT CORPORATION
New Castle, Delaware

N.A.C.A. COWLINGS
WHEEL PANTS

Any metal parts for an aeroplane that requires Spinning or Power Hammering.

300 Aircraft Streamliners Company
318-328 Reedy Street, Cincinnati, Ohio

PRACTICALLY NEW

Hamilton Metal Prop for J-5 engine—Just completely reconditioned by factory—$250

Write, wire or call—
MAJOR LESLIE G. MULZER
Wisconsin Rapids, Wis.

FOR SALE
Bellanca Pacemaker Monoplane

6-place cabin ship, 300 h.p. Wright J-6 Motor. Just overhauled and in perfect condition. Flown less than 350 hours. Will sell at sacrifice.

FS-16, Aviation
10th Ave. at 36th St., New York City

OX AMERICAN EAGLE

85 Hours.
Appearance and condition excellent.
Must sell at once, $750

E. H. GRANVILLE,
Springfield Airport
Springfield, Mass.

BARGAIN—$2,500, SAVOIA MARCHETTI AMPHIBION

Licensed N C 881 N, perfect condition, and only 52 flying hours on motor. Privately owned, has had excellent care. Can be inspected at Fairchild Airport, Farmingdale, L. I.

FS-48, Aviation
Tenth Ave. at 36th St., New York City

FOR SALE
Miscellaneous Accessories

Wicker Chairs and pumps, instruments of all kinds, magneto switches, engine driven fuel pumps, [illegible] pumps and tubs, landing lights, navigation lights. Many other items of all kinds. What do you need? Write

BELLANCA AIRCRAFT CORPORATION
New Castle, Delaware

SET OF NINE
J-5 CYLINDERS

Standard size, complete with pistons, rings, valves and overhead. Used less than fifteen hours. Cylinders have been inspected and calibrated by Wright Aeronautical Corporation who have passed them as new. List price $1,962. Will sell complete for $1,000 F.O.B. Wichita, Kansas. Also two Scintilla Magnetos from same engine for $75 each.

The Stearman Aircraft Company
Wichita, Kansas

American Eagle wrecked, $75 less motor. Glider Turnbuckles, 15c. Short & Mason 20,000 ft. Altimeter and Banking Indicator, $5.00. Aeroplane Hub with flange and bolts complete for automobile motors used in snow sleds, $1.00 each. Artificial Horizons, $19.00 each. DH Wheels, $7.00 each. Set Glider Blueprints, $3.00. Lawrance Engine, $125. Pusher Propellers, $15. New 80 HP LeRhone, original crate, $30.00 each.

MIDWAY AERO COMPANY
Box 282, St. Paul, Minnesota

WRIGHT J-5

Just completely overhauled to finest—Total time 392 hours. Not run since overhauled—Guaranteed A-1 condition, could be told from new engine—Has 111 overzise Pistons—for quick sale —$1650.00. Will ship subject to inspection.

Write, wire or call—
MAJOR LESLIE G. MULZER
Wisconsin Rapids, Wis.

CONVERT YOUR OX5 MOTOR
into a
Speedy Marine Power Unit
for
Speed Boat, Fast Runabout or Hydroplane
by using
"Capitol" Standardized Conversion Parts
Prices that will surprise you
The AUTO ENGINE WORKS, Inc.
Mfrs. of "CAPITOL" Marine Engines
St. Paul, Minn.

28-FOOT RUSSELL

Lobe Parachute, real white silk, new June 1st. Never Jumped. Same as new—Quick Sale $250. Ship subject to inspection.

Write, wire or call—
MAJOR LESLIE G. MULZER
Wisconsin Rapids, Wis.

AMERICAN EAGLE

Cost $7100, powered with J6 Whirlwind 165, has been flown 70 hrs., always kept in hangar, lots of extras and just like new. Will sacrifice for $3,300.

FLOYD FRUS
112 E. Lollwood, San Antonio, Tex.

NEW ANZANI ENGINES

120 HP.

10 cylinder radial air cooled.
Rebuilt to American Specifications.
Crank pins to American standard size.
American standard cylinder bore.
Aluminum alloy pistons.
Floating piston pins, aluminum retainer plugs.
Mechanically operated intake valves.
Two Scintilla magnetos, double ignition.
Intake manifold heater and oil cooler.
Gear pressure and scavenger pumps.
Babbitt connecting rod bearings.

A reliable, economical and long wearing Engine and suitable for any class of plane.

These Engines are new, unused and ready to run, complete with all equipment, ring manifold for exhaust and propeller hub at the special price of

$500 Each

Crated f.o.b. cars. $200 with order, balance on delivery. Only a limited number for sale, act quickly.

HUNT AIRCRAFT MFG. CO., Inc.
Piskeville, N. Y.

Used Wasp and Hornet Engines

at substantial price reductions.

Wasp Junior

used 80 hours, completely overhauled at factory.

The
United Airports of Connecticut, Inc.
Hartford, Connecticut.

1929 American Eagle Biplane, 3 place, A1, has Millerized OX-5 motor.

1929 Davis V-3 Monoplane, N.C. License, only used 60 hrs., powered with LeBlond "60"

1928 Buhl Speedwing Biplane, 3 place, brakes, etc., less J-5 Motor

One LeBlond "60" motor only used 15 hrs.

Make me an offer, separate or whole.

HARRY H. BROWN
130 Ringold St., Dayton, Ohio

Lambert R-266 Engine
90 H.P.

Used only a few hours for and purposes [illegible] careful operation. Perfect condition.

Complete ready to run. [illegible]

[illegible] electric starter and solenoid and push button starting complete. Battery 12 volt weighing 24 lbs. Ring exhaust manifold and carburetor heater.

Engines Standard [illegible]

We are installing new [illegible] and will sell the complete outfit for $[illegible].

Crated F.O.B. cars, $100 with order, balance on delivery.

HUNT AIRCRAFT MFG. CO. INC.
Piskeville, N. Y.

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Where to Fly

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Essential For Blind Flying

AND THE CLIMB INDICATOR IMPROVES ALL YOUR FLYING

Wherever you fly you always need the Climb Indicator. It is invaluable in maintaining desired altitude and correct longitudinal position. It also shows the rate at which your ship is climbing or descending. With its aid you can climb at the fastest rate—or stretch a glide—without stalling.

So important to safe flying is the climb indicator that the Aeronautics Branch of the United States Department of Commerce specifies this instrument as "suitable equipment" on all transport planes—for day as well as night flying.

"Without this instrument blind flying is absolutely unsafe," a man prominent in American military aviation writes in regard to the Climb Indicator. Of course he has a Pioneer Climb Indicator on his plane—as have all who know that despite long training and experience one's flying instincts can still be wrong at times.

Your plane should be equipped with a Pioneer Climb Indicator. Ask us for complete information.

PIONEER INSTRUMENT COMPANY

INCORPORATED • • • DIVISION OF BENDIX AVIATION CORPORATION
754 LEXINGTON AVENUE • • • BROOKLYN NEW YORK

908 DEARBORN BLDG., DEARBORN • BENDIX BUILDING, LOS ANGELES • 18 SPEAR ST., SAN FRANCISCO • 430 W. DOUGLAS ST., WICHITA • 2034 W. 62nd ST., CHICAGO
927 BENDIX ST., OTTAWA • STERNPLATZ 13 JOHANNISTHAL-BERLIN • GENERAL EUROPEAN REPRESENTATIVE, M. CALDERARA, 11 BIS RUE MONTAIGNE, PARIS

The new PM-1 Martin Flying Boat, latest service type coast patrol bomber. Fifty-five flying boats similar to this, and ten monoplane flying boats now are being built by the Martin Company for the U. S. Navy.

Above: New PM-1 Flying Boat engine installation, fully cowled.

Below-Structural skeleton of engine mount for the new P3M-1 Martin Flying Boat. Made of the finest tubular steel, designed to withstand far greater vibration than could possibly be imposed on it in service.

BUILT TO DEFY VIBRATION

Martin Engine Mounts Have Never Failed

VIBRATION is the great enemy of the aircraft *engine mount*. Generated by the engine itself, vibration works ceaselessly to shatter the supporting structure. That is why the Martin Company leaves nothing undone to insure *engine mounts of the utmost dependability*.

Only flawless steel exactly suited to the purpose is used. All welding is done by experts, then carefully inspected to guarantee perfectly fused joints. *Box gussets developed by Martin engineers* have greatly increased the strength and rigidity of the *engine mount* structure. *Engine mounting* bolts are held by spacers welded to the inside of the *engine mount* ring in an unique manner which insures the greatest bearing area and maximum welding surface.

The inside of tubular or hollow steel parts is coated by filling with hot anti-rust compounds or oil, then drained and the drain holes sealed. In all possible cases, steel tubes are hermetically sealed to prevent oxidation. Exterior steel surfaces are coated with iron oxide primer and then painted. Moreover, in assembling the nacelle, great care is taken to avoid the corrosive effects of placing dissimilar metals in physical or electrical contact.

No wonder *Martin engine mounts* defy vibration through long years of trouble-free service.

MARTIN U.S.A.

The GLENN L. MARTIN Company

Builders of Dependable Aircraft since 1909 • • • Baltimore, Maryland, U. S. A.

17 WORLD'S RECORDS

Above: Lee Shoenhair with his Wasp powered Lockheed—holder of six world's records. Upper right: Capt. Boris Sergievsky with his record-breaking Hornet powered Sikorsky. Lower right: the Ford, powered with three Wasp engines, in which Leroy Manning established his record for speed with load.

NOW HELD BY PRATT & WHITNEY

TWO more world's records have recently been established by planes equipped with Pratt & Whitney engines. Both are for speed over a specified distance, and one of these was made with a load of 2000 kilograms . . . just 409 pounds over two tons.

Flying a Ford, powered with three Wasp engines, Leroy Manning carried his 2000 kg. load over a 100 km. course at an average speed of 164.42 miles per hour—beating the best previous time by a margin of twenty-two miles per hour.

Lee Shoenhair of the B. F. Goodrich Rubber Company made the 1000 km. speed record in a Wasp powered Lockheed Vega. His average speed, made October 27, 1930, was 164.26 miles per hour. This is the same plane in which Shoenhair established five world's speed records with loads.

Pratt & Whitney engines now hold seventeen world's records—the largest number held by any airplane engine manufacturer. This is the situation as of December 11, 1930. These marks have been set for altitude, speed, range and endurance, covering the entire field of airplane performance. Airplane manufacturers and air transport operators can offer no more convincing proof of dependability than to say: "These planes are powered by Pratt & Whitney."

THE
PRATT & WHITNEY AIRCRAFT CO.
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Division of United Aircraft & Transport Corporation

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Quebec; in Continental Europe by Bavarian Motor Works, Munich; in Japan by Nakajima Aircraft Works, Tokyo.

Wasp* & Hornet* *Engines*

*REGISTERED TRADE-MARK